Juvenile Salmonid Monitoring in Clear Creek, California, from October 2008 through September 2009

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Abstract.—The U.S. Fish and Wildlife Service (FWS) has been conducting a juvenile salmonid monitoring project in Clear Creek, Shasta County, California, using a rotary screw trap (RST) at river mile (rm) 1.7 since December 1998. This monitoring project has three primary objectives: 1) calculate an annual juvenile passage index (JPI) for Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead / rainbow trout (*O. mykiss*) (STT), for inter-year comparisons and analyses of effectiveness of stream restoration activities; 2) obtain juvenile salmonid life history information including size, emergence timing, emigration timing, and potential factors limiting survival at various life stages; and 3) collect otolith and genetic samples from juvenile salmonids for analyses and developing baseline markers for the Clear Creek salmonid populations. Chinook run classifications show that late-fall, winter, spring and fall Chinook salmon were captured in our RST. However, due to overlapping spawn timing of spring and fall Chinook, and presence of both, it was problematic to index the juvenile passage using the RST at rm 1.7. Since 2003, we have used a weir to isolate adult spring Chinook upstream of rm 8.1 or in some cases rm 7.4. To better estimate the passage of juvenile spring Chinook, we placed a second RST at rm 8.3. Passage indices with 90% and 95% confidence intervals were generated for late-fall, spring and fall Chinook salmon from Broodyear (BY) 2008 and steelhead / rainbow trout from BY 2008 Age 0+ and BY 2009 Age 0. The spring Chinook index for BY 2008 from the Upper Clear Creek (UCC) RST was 96,166 for redds above the RST and was 121,622 after adjusting for redds below the RST and above the separation weir. The indices of passage for BY 2008 from the Lower Clear Creek (LCC) RST were as follows: 45,903 late-fall, 80,152 spring and 8,451,186 fall-run Chinook salmon. The steelhead / rainbow trout indices from LCC were as follows; 537 BY 2008 Age 0+, and 30,487 BY 2009. Mark and recapture trials were conducted from December 2008 through mid-May 2009 to determine RST efficiency at both locations and ranged from 1.4% to 16.5%. Due to high captures of juvenile STT, 3 mark and recapture trials with STT were conducted in late April. Efficiencies ranged from 5.4% to 6.2%. For consistency with previous years estimates, we did not use these efficiencies in our passage estimates but we will continue to pursue conducting them based on catch in the LCC trap.

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Introduction

The U.S. Fish and Wildlife Service (USFWS), Red Bluff Fish and Wildlife Office (RBFWO) have been monitoring juvenile salmonids in Clear Creek, Shasta County, California using a rotary screw trap (RST) at river mile (rm) 1.7, since December 1998 and with a second trap at rm 8.3 since 2003. This monitoring project has three primary objectives: 1) calculate an annual juvenile passage index (JPI) for Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead / rainbow trout (*O. mykiss*) (STT), for inter-year comparisons and analyses of effectiveness of stream restoration activities; 2) obtain juvenile salmonid life history information including size, emergence timing, emigration timing, and potential factors limiting survival at various life stages; and 3) collect otolith and genetic samples from juvenile salmonids for analyses and developing baseline markers for the Clear Creek salmonid populations. Rotary screw traps have been used as the primary means to evaluate trends in juvenile salmon abundance. While RSTs have limitations, they can be an effective monitoring tool, and can provide a reliable estimate of juvenile production when used consistently over a number of years (CAMP 2002, sec. 5-1).

Clear Creek is a west side tributary of the Sacramento River in Shasta County. Runs of Chinook salmon from the Sacramento River watershed, including late-fall-run (LFC), spring-run (SCS), and fall-run (FCS) inhabit Clear Creek. Spring Chinook salmon are listed as threatened (1999) under the Federal Endangered Species Act (ESA). Winter Chinook may have historically been present or may spawn opportunistically, however a naturally self-sustaining population of does not exist in Clear Creek. The California Central Valley *O. mykiss* (STT) population includes both anadromous (steelhead) and resident forms. The California Central Valley Steelhead population is listed as threatened by the ESA since March 1998.

Late-fall Chinook salmon migrate into Clear Creek, November through April, with peak migration in December and peak spawning occurring in January. Late fall Chinook primarily utilize the lower reaches of Clear Creek (Reach 6) for all life history phases. Spring Chinook salmon generally migrate into Clear Creek before late August, and spawn in the upper reaches (Reaches 1-5a; rm 7.4 - 18.1) in September and October (Figure 1). Fall Chinook spawning occurs soon after and often overlaps in time with the SCS, with 98-99% taking place in Reach 6 below the gorge cascade (S. Giovannetti, USFWS, personal communication). A picket weir is used to prevent FCS from spawning in the upper reaches.

Restoration of anadromous salmonid populations in Clear Creek is an important element of the Central Valley Project Improvement Act (CVPIA). The CVPIA has a specific goal to double populations of anadromous fishes in the Central Valley of California. The Clear Creek Restoration Program authorized by Section 3406 (b) 12 of CVPIA, has funded many anadromous fish restoration actions which were outlined in the CVPIA Anadromous Fisheries Restoration Program (AFRP) Working Paper (USFWS 1995), and Draft Restoration Plan (USFWS 1997; finalized in 2001).

Since 2003, the RBFWO has used a second Upper Clear Creek (UCC) RST at rm 8.3 to index passage of SCS. Passage indices of the SCS using the Lower Clear Creek (LCC) RST rm 1.7 were found to be significantly underestimated (Gaines 2003, Greenwald 2003, and Brown 2007). The picket weir was placed instream when the adult snorkel survey determined that the majority of SCS had passed upstream of rm 8.1. The picket weir location was at rm 8.1 (Table 2) in 2003-2005. In 2006-2008, the picket weir was placed at rm 7.4 because adult SCS observed during the June snorkel survey had not passed upstream of the rm 8.1 location. The use of the picket weir has greatly minimized the presence of FCS in the upper watershed. This report presents sampling data from the upper and lower Clear Creek RSTs. All passage data is from brood years whose emigration ended between October 1, 2008 and September 30, 2009.

Study Area

The Clear Creek watershed below Whiskeytown Dam covers an area of approximately 48.9 $miles^2$ ($127\ km^2$), and receives supplemental water from a cross-basin transfer between Lewiston Lake in the Trinity River watershed and Whiskeytown Reservoir in the Sacramento River watershed. Separated at the Clear Creek Road Bridge, the upper and lower reaches of the creek are geomorphically distinct and support different fish communities. The upper reach flows south from Whiskeytown Reservoir almost 10 mi (16.1 rkm). The lower reach heads in an easterly direction to the Sacramento River for a distance of approximately 8.2 mi (13.5 rkm) (Figure 1). In the upper reach the stream is more constrained by canyon walls and a bedrock channel, has a higher gradient, has less spawning gravel and has more deep pools. In the lower reach, the stream meanders through a less constrained alluvial flood plain, has a lower gradient, has more spawning gravel and has fewer deep pools. The lower reach is managed for fall and late-fall Chinook and supports species of the foothills fish community. The upper reach supports coldwater species and is managed for spring Chinook and steelhead / rainbow trout, which require cooler summer water temperatures than the runs downstream.

Acting as a sediment trap, Whiskeytown Reservoir has starved the lower portion of Clear Creek of its sediment. The coarse sediment deficit and concomitant reduction in habitat quality in Clear Creek below Whiskeytown Dam has been well documented by various investigators (Coots as cited in McBain and Trush 2001, GMA 2003). Effects of reduced coarse sediment supply include riffle coarsening, fossilization of alluvial features, loss of fine sediments available for overbank deposition and riparian re-generation, and a reduction in the amount and quality of spawning gravels available for anadromous salmonids (GMA 2006). In some areas of the Clear Creek, stream channel only clay hardpan or bedrock remains, thus the need for gravel supplementation.

Ambient air temperatures range from approximately 32°F (0ºC) in winter to summer highs in excess of 115°F (46ºC). Most precipitation falls into this watershed as rainfall. The average rainfall in the Clear Creek watershed ranges from approximately 20 inches (50cm) in the lowest elevations to more than 60 in. (152 cm) in the highest elevations. Most of the watershed's rainfall occurs between November and April, with little or none occurring during the summer months (McBain and Trush et al. 2000).

The upper Clear Creek rotary screw trap is located at rm 8.3 (rkm 13.4) above the confluence with the Sacramento River (latitude 40º 29' 30" north, longitude 122º 29' 46.8" west). The lower Clear Creek rotary screw trap is located at rm 1.7 (rkm 2.7) above the confluence (latitude 40º 30' 22" north, longitude 122º 23' 45" west). The RSTs operate in or near the thalweg of the channel at both locations. The stream gradients at these locations range from approximately 1 - 1.5 degrees. The creek bottom substrate at these locations is primarily composed of gravel and cobble. The creek's riparian zone vegetation in these areas is dominated by willow (*Salix* sp.), cottonwood (*Populus sp.*), and Himalayan blackberry (*Rubus discolor*). Canopy cover of the riparian vegetation over the channel in the sampling areas is generally less than 5%.

Methods

Sampling protocol—Sampling for juvenile salmonids in Clear Creek was accomplished by using standardized RST sampling techniques that generally were consistent with the CVPIA's Comprehensive Assessment and Monitoring Program (CAMP) standard protocol (CAMP 1997). The RSTs deployed in Clear Creek, are manufactured by E.G. Solutions®, Corvallis, Oregon. This type of trap consists of a 5 ft (1.5 m) diameter cone covered with 3-mm diameter perforated stainless steel screen. This cone acts as a sieve, which separates fish from the sampled water. The cone is supported between two pontoons and its auger-type action passes water, fish, and debris to the rear of the trap, and directly into a live box. This live box retains fish and debris, and passes water through screens located in its back, sides, and bottom.

We selected two trees with diameter-at-breast height measurements of approximately 12-18 in. (30 - 46 cm) on opposite banks of the creek to use as attachment points for the traps for securing the RST in the thalweg of Clear Creek. The trees were approximately 200 ft. (60 m) apart and far enough above the flood plain to avoid most flood waters. Using these trees as anchors, the RST is attached to a cable high line and positioned in stream with a system of ropes, and pulleys. The UCC RST was fished during the current reporting period from November 14, 2008 through February 18, 2009. The LCC RST was also fished from November 14, 2008 through July 02, 2009. An attempt was made to fish the RST 24-hours per day, seven days each week. Methods for access and data collection were identical for both traps.

Fisheries crews typically accessed the RST by wading from the creek banks. However, for crew access during higher flows, the RST was pulled into shallow water for boarding. After being serviced, the RST was returned back to the thalweg as soon as possible to begin fishing again. The RST was serviced once per day unless high flows, heavy debris loads, or high fish densities required multiple trap checks to avoid mortality of captured fish or damage to equipment. At each trap servicing, crews process the collected fish, clear the RST of debris, provide maintenance, and obtain environmental and RST data. Collected data included dates and times of RST operation, creek depth at the RST, RST cone fishing depth, number of rotations of the RST cone, the amount and type of debris collected, basic weather conditions, water temperature, current velocity, and water turbidity. Water depths were measured using a graduated staff to the nearest 0.1 feet. The RST cone fishing depth was measured with a gauge that was permanently mounted to the RST frame in front of the cone. The number of rotations of the RST cone was measured with a mechanical stroke counter (Global Industrial Products, Battle Ground, WA) that was mounted to the RST railing adjacent to the cone. The amount of debris in the RST was volumetrically measured using a 10-gallon plastic tub. Water temperatures were continuously obtained with an instream Onset HOBO® Water Temp Pro v2 Logger. Water velocity was measured from a grab-sample using an Oceanic® Model 2030 flowmeter (General Oceanics, Inc., Miami, Florida). This velocity was measured in the time when the live box of the RST was being cleared of debris and the fish sorted from this debris. Water turbidity was measured from a grab-sample with a Hach® Model 2100D turbidimeter (Hach Company, Ames, Iowa).

To remove the contents of the RST live well for examination, we used dip nets to scoop debris and fish onto a sorting table. When the number of all fishes collected in the RST was less than approximately 250 individuals, we counted and measured all fishes while on the aft deck of the RST. When catch exceeded approximately 250 individuals, fishes were transported to the shore in 5-gallon buckets and put into 25-gallon buckets until further examination.

Counting and measurement—We counted and obtained length measurements (to the nearest 1.0 mm) for all fish taxa that were collected. Counts and measurements were also generated for mortalities for each fish taxa. Fish to be measured were first placed in a 1-gallon plastic tub and anesthetized with Tricaine Methanesulfonate (MS-222; Argent Chemical Laboratories, Inc. Redmond, Washington) solution at a concentration of 60 - 80 mg/l. After being measured on a wet measuring board with wet hands, the fish were placed in a 10-gallon plastic tub that was filled with fresh creek water to allow for recovery from the anesthetic effects before being released back into the creek. Water in the tubs was replaced as necessary with fresh creek water to maintain adequate temperature and oxygen levels. Due to the large numbers of juvenile salmon that were frequently encountered, and project objectives, we used different criteria to count salmon, trout, and non-salmonid species:

Chinook salmon—When less than approximately 250 salmon were collected in the RST, all were counted and measured for fork length (FL). The measured juvenile salmon were assigned a life-stage classification of fry, parr, silvery parr, or smolt. For all Chinook salmon that were counted and measured, we also assigned run designations, using length-at-date tables from Greene (1992). These designations included fall-run, late-fall-run, winter-run, or spring-run. At the UCC RST all Chinook captured were considered to be SCS, due to the use of the weir which blocked FCS from passing upstream of the RST, regardless of their designation by the length-at-date tables.

When more than approximately 250 juvenile salmon were captured, subsampling was conducted. To conduct the subsampling, a cylinder-shaped 1/8" mesh "subsampling net" with a split-bottom construction was used. The bottom of the subsampling net was constructed with a metal frame that created two equal halves. Each half of the subsampling net bottom was built with a mesh bag that was capable of being tied shut, however, just one side was tied shut and the other side was left open. This subsampling net was placed in a 25-gallon bucket that was partially filled with creek water. All collected juvenile salmon were poured into this bucket. The net was then lifted, resulting in a halving of the sample. Approximately one-half of the salmon were retained in the side of the net with the closed mesh bag, and approximately one-half of the salmon in the side with the open mesh bag were left in the bucket. We successively subsampled until approximately 150 - 250 individuals remained. The number of successive splits that we used varied with the number of salmon collected, from one split (= ½ split) and occasionally up to seven splits (= 1/128 split).

After subsampling the salmon to the appropriate split, all fish in the subsample of approximately 150 - 250 individuals were counted and measured for FL. These salmon were also assigned a life-stage classification and run designation, using the methods previously described above. We proceeded to successively count all salmon in each split, until all salmon were counted.

Chinook salmon with forklengths greater than or equal to 50mm were weighed to the nearest 0.01gram for length / weight relationship analysis. The multi-year analysis will compare data from 2007-2010 and be released in the 2010 monitoring report.

Steelhead / rainbow trout—We counted and measured the FL of all steelhead / rainbow trout that were collected in the RSTs. Life stages of juveniles were classified similarly as Chinook. Steelhead / rainbow trout were classified as one of the following yolk-sac fry, fry, parr, silvery parr, or smolt. We weighed all collected juvenile steelhead / rainbow trout equal to or larger than 50 mm FL to the nearest 0.01-gram using a batteryoperated Ohaus Scout® digital scale (Ohaus Corporation, Florham Park, New Jersey). Steelhead / rainbow trout juveniles were also given a maturation status of unknown.

Non-salmonid taxa—All non-salmonid taxa, were counted and up to 20 randomly selected individuals were measured. We measured the total length for lamprey (*Lampetra spp*.), cottids (*Cottus spp*.), and western mosquitofish (*Gambusia affinis*), and measured the FL for all of the other non-salmonid taxa. Catch data for all fish taxa were typically consolidated to represent monthly sums. Our sampling weeks were identified by year and number. Our first sampling week of the current study was during Week # 46 in 2008, and the last sampling week was during Week # 27 in 2009 (Table 2).

Genetic and otolith sampling—Genetic samples were taken on selected Chinook salmon for the purpose of run identification. Samples were taken by removing a 1-mm^2 tissue sample from the top or base of the caudal fin. The samples were divided into three equal parts and placed in 2-ml triplicate vials of the same record number with 0.5 ml of ethanol as a preservative. The triplicate samples were taken for; 1) USFWS archive, 2) CDFG archive, and 3) analysis by the Oregon State University's Hatfield Marine Lab in Newport, Oregon.

We anticipated sampling up to one hundred otolith samples from LCC steelhead / rainbow trout. Samples that were less than 50 mm FL were euthanized and placed in 60-ml vials with 40 ml of ethanol. Samples that were 50 mm or greater were euthanized and stored frozen.

Mark and recapture efficiency techniques—One of the objectives of our monitoring project is to develop a passage index of the number of juvenile salmonids passing downstream in a given unit of time, usually in a given week or year. We call this estimate a juvenile passage index (JPI). Since the RST only captures fish from a small portion of the creek cross section, we needed to implement a method to project the RST catch numbers to parts of the creek outside of the RST capture zone. We needed to determine the efficiency of the RST to catch all juvenile salmonid species moving downstream during a given time period. By determining the RST efficiency, we were able to calculate a JPI from the actual catch. To determine efficiencies of the RST, mark-recapture trials were conducted.

During periods when juvenile Chinook salmon capture was sufficient and weather permitted, mark-recapture trials were attempted twice weekly. We attempted to mark 400 juvenile Chinook salmon for each trial, with a goal to recapture at least 7 marked individuals. In an effort to meet our goal of recapturing a minimum of 7 individuals, we generally did not conduct mark-recapture studies during periods when numbers of juvenile salmon captured were less than about 200 individuals.

Only naturally produced (unmarked, unclipped, and untagged) juvenile salmon captured by the RST were used for mark-recapture trials. We used either a single mark or a dual mark, to mark the salmon over the course of the study period. Single marking was used when our releases of marked salmon occurred more than five days apart, and when USFWS was not actively conducting salmon mark-recapture studies at nearby locations. The USFWS conducts mark and recapture trials at the Red Bluff Diversion Dam (RBDD), for estimating trap efficiency while monitoring Sacramento River juvenile salmonid populations. The dual mark allowed RBDD to distinguish Clear Creek marked Chinook from RBDD marked Chinook. The methods used for single-marking and dual-marking are described below:

Single-marking technique—Our single-marking technique consisted of immersion staining of salmon with Bismarck brown-Y stain (J.T. Baker Chemical Company, Phillipsburg, New Jersey). The Bismarck brown was applied at a concentration of 1.6 grams / 20 gallons of water and allowed a 45-50 minute contact time.

Dual-marking techniques—To conduct our dual-marking procedures, the fish are anesthetized with an MS-222 solution at a concentration of 60-80 mg/l. After the salmon are anaesthetized, we use either an upper or lower caudal fin clipping to attain a primary mark. To perform the fin clips, we use surgical scalpels, to remove an area of approximately 1 mm^2 or less from the corners of the caudal fin lobe. Alternate upper and lower clips are used to discern mark groups from trial to trial and trap to trap. After we complete the clipping process, we mark the salmon with Bismarck brown, as described above.

When the single-marking or dual-marking procedures were completed, the marked juvenile salmon were placed in a live car and allowed to recover overnight in the RST live well. This overnight detention allowed us to detect salmon with latent injuries and mortalities resulting from the marking procedure, and removed them from use in the recapture trials. On the following evening, weak, injured, and dead fish were removed. The remaining fish were counted and transported 0.25-0.5 river miles upstream of the RST sampling site to be released. We attempted to release fish in the evening no earlier than 15 minutes before sunset. The nighttime releases of marked fish were designed to: 1) reduce the potential for unnaturally high predation on salmon that may be temporarily disorientated by the transportation; and 2) imitate the tendency for natural populations of outmigrating Chinook salmon to move downstream primarily at night (Healey 1998; USFWS, RBFWO, unpublished observations). The stained and marked Chinook salmon that were recaptured later by the RST were counted and measured. After being allowed to recover, they were released downstream of the RST to prevent them from being recaptured again. In most cases when flows would most certainly exceed 2,000 cfs, fish were released downstream of the trap and efficiency trials are not conducted.

Trap efficiency—The trap efficiency was calculated by dividing the number of recaptured juvenile Chinook salmon by the number of released (# recaptured / # released) from the trial group. Efficiencies calculated from the mark-recapture trials were used to generate weekly JPIs (JPI = the sum weekly catch of each salmonid species captured divided by a weekly efficiency) for Chinook salmon and steelhead / rainbow trout using methods described by Thedinga et al. (1994) and Kennen et al. (1994).

Juvenile passage indices for salmonids were generated by summing the daily catch for each salmonid species and run and dividing by the trap efficiency for that week to determine a weekly passage. When instream flow fluctuations occurred or a trial did not recapture 7 recaptures to generate statistically sound estimates, the trial was excluded and a “season” efficiency value was used. Additionally, for the period preceding the first trial and proceeding a week after the last trial of the season we used the season efficiency. Season efficiency values were calculated by dividing the average of fish released from all valid mark and recapture trials and dividing it by the average of all trial recaptures.

1) Weekly trap efficiencies were generated using a stratified weekly estimator, which is a modification of the standard Lincoln-Peterson estimator (Bailey 1951; Steinhorst et al. 2004). The weekly estimator was used as it performs better with small sample sizes and is not undefined when there are zero recaptures (Carlson et

al. 1998; Steinhorst et al. 2004). In addition, Steinhorst et al. (2004) found it to be the least inaccurate of three estimators (Whitton et al., 2006).

Weekly trap efficiencies were generated by use of the equation:

$$\hat{E}_h = \frac{(r_h + 1)}{(m_h + 1)},$$

Where;
E is the calculated trap efficiency,
r_h is the number of marked fish recaptured in week h,
m_h is the number of marked fish released in week h.

When more than one mark and recapture trial took place and there was no significant change in environmental factors (i.e., cfs or temperature), the trials were pooled to get a weekly efficiency.

2) Weekly JPIs for Chinook salmon and steelhead trout were calculated using weekly catch totals and either the weekly trap efficiency, pooled trap efficiency, or average season trap efficiency. The season was stratified by week or at times multiple strata per week because as Steinhorst et al. (2004) found, combining the data where there are likely changes in trap efficiency throughout the season leads to inaccurate estimates. Using methods described by Carlson et al. (1998) and Steinhorst et al. (2004), the weekly JPIs were estimated by

$$\hat{N}_h = \frac{U_h}{\hat{E}_h},$$

Where;
N_h is the passage during week h,
U_h is the unmarked catch during week h,
E_h is the calculated trap efficiency during week h.

The variance, 90% and 95% confidence intervals (CI's) for each week (N_h) are determined by the percentile bootstrap method with 1,000 iterations (Efron and Tibshirani 1986; Buckland and Garthwaite 1991; Thedinga et al. 1994; Steinhorst et al. 2004). Using data with simulated numbers of migrants, and trap efficiencies, Steinhorst et al. (2004) determined the percentile bootstrap method for developing CI's performed the best as it had the best coverage of a 95% CI. The variance for N_h is simply the sample variance of the 1,000 iterations of N_h produced by bootstrapping U_h, E_h and m_h for each week.

As described by Steinhorst et al. (2004), and demonstrated by Whitton et al. (2006), the 90% and 95% CI's for the weekly JPIs were found by producing 1,000 iterations of N_h and locating the 25^{th}, 50^{th}, 950^{th}, and 975^{th} values of the ordered estimates. The 1000 iterations were produced by using a macro in the Systat 10 software program, which used the weekly catch, the calculated efficiency, and the number of marked fish for each trial. The macro produced 1000 variable numbers of recapture from which passage estimates were generated; these latter data were placed in a Microsoft Excel spreadsheet and subsequently ordered from low to high values. A separate spreadsheet was kept for both sets of data, ordered, and unordered. The unordered and ordered data sets were used to determine the final CI and weekly CI, respectively.

This final CI was calculated by summing the stratum of each of the 1000 random unordered iterations horizontally on the spreadsheet. The final column was ordered and the 25th, 50th, 950th, and 975th values were used as the 90% and 95% CI. The final JPI CI uses unordered iterations in calculating values, as summing the ordered iterations produce a CI that is comprised of non-random values. To produce a weekly CI, each weekly stratum is ordered and the 25th, 50th, 950th, and 975th values were used as the 90% and 95% CI.

The standard deviations *(SD)* of the sample means of each stratum are also included with 90% and 95% CI's. Juvenile Chinook salmon and STT JPIs were summarized by brood year.

For dates when sampling was not conducted, or when samples were lost or compromised, we used the mean catch of an equal number of days before, and an equal number of days after, the missing number of sample days to create a surrogate value. For example, if we were missing three days of sampling data, we would calculate the average of the three sampled days before and three sampled days after the missing period. This calculated average of six sampled days would then be used as the surrogate value for each of the three days of missing values. On days where more than half of the day was sampled, a proportionate value was given to the remainder of the day the trap did not fish based on the data that was collected.

Trap modifications—During periods of high salmon outmigration, we implemented a modification in the RST to reduce potential negative affects to juvenile salmon created by high fish densities. We implemented this "half-cone modification" to the RST by placing an aluminum plate over one of the two existing cone discharge ports and removing an exterior cone hatch cover. This created a condition where 50% of the collected fish and debris were not collected into the live-box, but were discharged from the cone into the creek. This effectively reduced our catch of both fish and debris by 50%, and reduced crowding of fish in the live-box.

In addition to the half-cone modification described above, we performed several other modifications to the RST equipment and operations to provide for greater protection to collected fishes. Other modifications to RST equipment included enlarging the size of live-box, increasing the size of flotation pontoons. Additionally, a secondary flotation device was added to the rear of the trap to keep it from sinking and getting fish crushed between the live box and cover lids. Inside the live box, we have added a midway fish exclusionary device made of expanded aluminum. This device prevents large predatory fish from harassing smaller salmonids. Modifications to RST operations have included day and night sampling during the peak out migration periods for SCS and FCS. To improve JPI computation, we strived to fish high flow events when juvenile salmonids are thought to out-migrate and increase the frequency of mark-recapture trials during those events from previous years.

Results

Sampling effort

Upper Clear Creek—We operated the UCC RST for 97 days. The UCC RST was installed on November 4, 2008 and set from November 14, 2008 through February 18, 2009. Based upon our experience in sampling previous years, we expected to catch consistently few or zero salmonids in the period from the beginning of August through mid-November. Although, length-at-date tables suggest we might capture SCS as early as October 16 of each year; using temperature data for 2008 (and surrogate values of 2007 from 10/20-12/31 due to < 1ºF difference) we calculated that SCS emergence would not occur until mid-November. The first ten days after trap installation were not sampled based on the temperature analysis. Due to anticipated high flows, three days were not sampled. Due to high juvenile Chinook salmon densities that were anticipated and encountered, we applied the half-cone modification during the entire sampling season.

Lower Clear Creek—We operated the LCC RST for 210 days. The LCC RST was installed on November 4, 2008 and set from November 14, 2008 through July 2, 2009. Due to high flows, nine days were either partially sampled or not sampled at all. Twelve weekend days were not sampled due to staff shortages in the later part of the sampling season. Due to high juvenile Chinook salmon densities that were anticipated and encountered, we applied the half-cone modification during the period from November 14, 2008 through December 2, 2008 and again from January 14, 2009 through March 17, 2009. The full cone was applied from December 3, 2008 through January 13, 2009 as well as during the period from March 18, 2009 through the end of the trapping season.

Physical characteristics

Stream discharge at the study site was approximated by using the U.S. Geological Survey Igo gauging station, located approximately 1.9 river miles above the UCC RST sampling site (Figure 1). Mean daily flows ranged from a minimum of 142 cubic feet per second (cfs) on July 2, 2009 to a maximum of 1,130 cfs on February 23, 2009. The maximum measured hourly flow recorded was 2,700 cfs on the evening of February 23, 2009. The maximum 15-minute flow recorded was 2,920 cfs of that same evening. The minimum flows were from controlled releases out of the Whiskeytown Lake, while maximums were results of natural storm flow accretions.

Upper Clear Creek—The channel width of Clear Creek at the UCC RST varied from approximately 30 feet at the lowest flows to more than 130 feet at the highest flows. Water depths in Clear Creek at the base of the RST cone varied from 3.9 feet to 5.7 feet, with an average depth of 4.9 ft. The lowest depths were recorded during late November 2008, and the deepest depths were recorded in mid February 2009.

Turbidity levels ranged from 0.69 nephelometric turbidity units (NTU) in January 2009 to 5.45 NTU in February 2009, with a mean turbidity of 1.3 NTU. Turbidity was typically the lowest during the lower flows of summer, and tended to increase during the higher winter flows (Figure 2). Mean daily water temperatures during the sampling season at UCC ranged from a low of 44.2^{o}F on January 3, 2009 to 52.3^{o}F on November 14, 2008(Figure 3).

Lower Clear Creek—The channel width of Clear Creek at the LCC RST varied from approximately 40 feet at the lowest flows to more than 150 feet at the highest flows. Water depths in Clear Creek at the base of the RST cone varied from 2.5 feet to 4.6 feet, with an average depth of 2.9 ft. The lowest depths were recorded during November 2008, and the deepest depths were recorded in mid-March 2009.

Turbidity levels ranged from 0.58 NTU in January 2009 to 42.6 NTU in May 2009, with a mean turbidity of 2.6 NTU.

Mean daily water temperatures ranged from a low of 43.4^{o}F on January 3, 2009 to 66.0^{o}F on June 28, 2009 (Figure 3). Temperatures are measured year round; however, the values above represent temperatures for the days that were actually sampled.

Fish assemblage

Upper Clear Creek—A total of 11,720 fish, represented by 7 fish taxa were collected in the UCC RST during the sampling period. The most abundant fish taxa collected were Chinook salmon, steelhead / rainbow trout, California roach (*Hesperoleucus symmetricus*), riffle sculpin (*Cottus gulosus*), Sacramento sucker (*Catostomus occidentalis*), hardhead (*Mylopharodon conocephalus*) and Sacramento pikeminnow (*Ptychocheilus grandis*). The UCC RST capture data is reported below.

Chinook salmon—The only species of salmon collected was Chinook salmon. Length-at-date tables of Greene (1992) indicated that we collected SCS, LFCS, WCS, and FCS. We captured 11,626 Chinook during the study period. On November 21, 2008, February 2, 2009 and February 13, 2009 Chinook salmon of 121 mm, 72 mm and 74 mm respectively, were captured. These Chinook were likely to be LFCS BY 2008 and were not calculated in the SCS BY 2008 passage index. The latter fish were designated as WCS by length-at-date tables. The WCS were more likely to be LFCS based on FL's and growth trajectory compared with that of the first LFCS captured on November 21, 2008. The data trends for each run of Chinook salmon are summarized below.

Spring-run Chinook salmon—The LCC passage indices relied exclusively on length-at-date tables to separate juvenile SCS from FCS. UCC indices relied on the picket weir to confine adult FCS below the trap and thus assign all length-at-date FCS as SCS. Fork lengths for all BY 2008 spring Chinook salmon captured, ranged from 29 – 68 mm, with a median of 34 mm (Figure 4). Chinook of all life stages were collected (Figure 5). We collected the greatest number of Chinook salmon from the fry size class, with the majority of individuals (99.2%) being 39 mm or less in FL (Figure 6 and Figure 7). The JPI for BY 2008 SCS was 96,052, with upper and lower 95% CI's of 104,402 and 88,834. Peak emigration occurred over a 9-week period from early December 2008 through early February 2009 (Figure 8 and Table 3). The passage indices for SCS at LCC between 1998 and 2008 on average were 25,977. In the six years (2003-2008) of using the UCC RST and the picket weir, the average SCS passage index is 108,844.

The JPI recorded at the UCC trap was the lowest to date, however, of the 86 SCS redds that were observed above the separation weir, 21% were below the UCC RST. The adjusted population (proportionate to juveniles per redd) to include the redds below the trap and above the separation weir would be 121,622. The adjusted estimate of JPI is then the second highest we have recorded (Figure 23). The six-year average including all redds above the separation weir is 118,751.

Steelhead / rainbow trout—BY 2009 STT were not captured in the UCC RST from January 1, 2009 to the end of the trapping season on February 18, 2009. Indices of passage and confidence intervals were not generated from the upper RST because the distribution of spawning was both above and below the trap site (Giovannetti and Brown 2007).

Non-Salmonids—We collected 7 non-salmonids in the UCC RST. Three California roach, one hardhead, one Sacramento sucker, one riffle sculpin and one Sacramento pikeminnow. The common and scientific name key for non-salmonids is described in Appendix 1. All other occurrences of non-salmonid species are summarized in Appendix 2.

Lower Clear Creek—A total of 336,587 individual fish, represented by 20 fish taxa were collected in the LCC RST during the sampling period. The most abundant fish taxa collected were Chinook salmon, followed by steelhead / rainbow trout, pacific lamprey (*Lampetra tridentata)*, lamprey ammocoetes (*Lampetra or Entosphenus spp*.) and riffle sculpin (*Cottus gulosus*). The LCC RST capture data are reported below.

Chinook salmon—Data is summarized by the following dates for BY 2008; late-fall April 1 2008 to March 31, 2009, winter Chinook July 1, 2008 to June 30, 2009, spring and fall Chinook October 1, 2008 to September 30, 2009. The only species of salmon collected was Chinook salmon. Length-at-date tables of Greene (1992) indicated that we collected individuals from all four Chinook salmon runs known from the Sacramento River basin. Three hundred thirty-six thousand, five hundred eighty-seven individuals were captured from all runs, during the study period. Fork lengths for all runs of Chinook salmon ranged from 21-112 mm, with a median of 37 mm (Figure 9). Chinook of all life stages were collected (Figure 10). We collected a greater number of Chinook salmon from the fry size class, with the majority of individuals being 39 mm or less in FL. Data trends for each run of Chinook salmon are discussed below.

Late-fall-run Chinook salmon—A total of 2,537 LFC were captured. Of the 2,360 LFC that were measured, 74 % were in the 30-39 mm FL range (Figure 11). The most common life stage for LFC was fry at 76% (Figure 12). Peak emigration occurred from approximately April 2, 2008 through May 27, 2009, when 84% passed (Table 4). The JPI for BY 2008 LFC was 45,903 with upper and lower 95% CI's of 54,452 and 39,129 (Table 4 and Figure 13).

Winter-run Chinook salmon—A total of 91 juvenile Chinook salmon were designated as winter-run Chinook. Due to the low number of WCS captured, a passage index was not generated. Seven of the 91 Chinook indexed to have passed were actually captured; the other 84 were derived from proportionate extrapolation of capture data. . The WCS display a similar size and passage timing to that of the LFC, suggesting that most likely they are late spawned LFC.

Spring-run Chinook salmon—Length-at date tables show SCS were collected at LCC. There were 2,655 SCS captured at the LCC RST. Peak emigration occurred from late November through December. The JPI for BY 2008 SCS was 80,152 with upper and lower 95% CI's of 129,023 and 56,681. The passage index for SCS is determined by using the UCC RST. The data presented here for LCC RST is underestimated, and provided for comparison purposes.

Fall-run Chinook salmon—A total of 324,350 FCS were captured. The JPI for BY 2008 FCS was 8,451,186 with upper and lower 95% CI's of 10,397,719 and 7,129,073 (Table 5). Fall-run Chinook salmon make up > 97% of all Chinook salmon captured. Approximately 85% of the 25,729 FCS that were measured were in the 30-39 mm FL range, and 7% were in the 40-49 mm FL range (Figure 14). The most common life stage for FCS was fry 89% (Figure 15). Peak emigration occurred from January 2009 through February 2009 (Figure 16). The highest weekly passage occurred during the week of February 5, 2009 where 2,067,938 individuals were estimated to have passed (Figure 16 and Table 5).

Steelhead / rainbow trout—Passage indices are generated for BY 2009, from January 1 to July 2, 2009. During BY 2009 2,098 STT were captured from January 1, 2009 to July 2, 2009. Seven additional captures where made from November 25, 2009 through December 31, 2009. Those seven captures are not included in this report and the BY2009 passage will be amended in the 2010 report. Steelhead / rainbow trout during 2009 had forklength measurements ranging from 21-430 mm (Figure 17). Steelhead / rainbow trout were captured from all life stage classifications yolk-sac fry, fry, parr, silvery parr and smolt (Figure 18). Steelhead / rainbow trout fry made up 87.4% of the total catch while, 86.3% of those measured were in the 20-39 mm size range (Figure 19). The JPI for BY 2009 STT is 30,487 with upper and lower 95% CI's of 33,599 and 28,103 (Table 6). The most common life stage for juvenile STT was fry (Figure 20). Peak emigration of juvenile steelhead fry occurred from mid-March through April of 2009 (Figure 21). Eighteen STT were captured that were considered Age 0+ from BY 2008 or earlier. A passage index of 537 was generated on those captures. Age 0+ passage data from 1998-2008 is summarized in Table 20.

Non-salmonids—We collected a total of 901 individual non-salmonids from 17 taxa. The most abundant non-salmonids included Pacific lamprey, lamprey ammocoetes, riffle sculpin, California roach, Cyprinoidea fry and hardhead. The common and scientific name key for non-salmonids is presented in Appendix 1. These dominant non-salmonid taxa are discussed below; all others are summarized in Appendix 3.

California roach—A total of 103 were collected. California roach were collected throughout the sampling season with peak capture in June 2009.

Cyprinoidea fry—A total of 66 unidentified Cyprinid fry were collected. Individuals from this taxon were likely hardhead, Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow, and speckled dace (*Rhinichthys osculus*).

Hardhead.—A total of 53 were collected. Hardhead were collected throughout the sampling season with peak capture in April and May.

Lamprey fry—A total of 187 unidentified lamprey fry were collected. Individuals from this taxon were likely Pacific lamprey (*Lampetra tridentatus*), and possibly may have also included western brook lamprey (*L. richardsoni*) and river lamprey (*L. ayresi*).

Pacific lamprey—A total of 214 Pacific lampreys were collected. Pacific lampreys were collected throughout the sampling season with peak passage in February 2009.

Riffle sculpin—A total of 138 riffle sculpin were collected. Riffle sculpin were collected throughout the sampling season.

Sacramento pikeminnow—A total of 22 Sacramento pikeminnow were collected. Sacramento pikeminnow were collected throughout the sampling season with peak capture in March 2009.

Genetic and otolith sampling—We collected 503 genetic samples of Chinook salmon during this sampling season. Two hundred eighty-two samples were collected from UCC and 221 were collected from LCC. Samples at both locations were taken at a rate of 10 samples per week, if enough fish were available. During the genetic sampling process, samples of various forklengths were taken when possible to avoid sampling siblings that might potentially bias the genetic analysis. We collected 91 STT otolith samples from LCC. Three samples were > 50 mm, one was 50 mm and 87 samples were < 50 mm.

Mark and recapture efficiency estimates

Upper Clear Creek—We conducted 20 mark-recapture trials to test for RST efficiency. The release of marked fish started on December 6, 2008 and ended on February 11, 2009. 7,952 Chinook salmon were released, 11 mortalities occurred from the marking procedures and 879 were recaptured (Table 8). During all 20 trials Chinook were dual marked with Bismarck Brown and an upper or lower caudal fin clip, to distinguish between multiple weekly release groups and trap locations.

The number of individual fish released for each trial ranged from 300-428, with an average of 398. Recaptured fish numbers per trial ranged from 9-61 with an average of 44. Efficiencies ranged from 2% to 16.5% per trial, with an average of 11% (Table 9).

Due to low fish collection numbers, we were unable to conduct mark and recapture studies from November 14 until December 5, 2008. As described in the methods, for the periods from November 14 through December 1, 2008 (weeks 46-48) we substituted the "season" efficiency. The seasonal efficiency was calculated by dividing the average number of released fish (398+1) of the 20 trials by the average number of recaptures (44+1). Therefore, the seasonal average was 11.3% (44+1/398+1).

Lower Clear Creek—We conducted 30 Chinook salmon and 3 steelhead / rainbow trout mark-recapture trials to test for RST efficiency's at full cone and at half cone. The release of marked fish started on December 18, 2008 and ended on May 12, 2009. A total of 11,957 Chinook salmon were released, 40 mortalities occurred from the marking procedures, and 792 were recaptured (Table 10). During all 30 trials Chinook were dual marked with Bismarck Brown and either an upper or lower caudal fin clip, to distinguish between multiple weekly release groups and concurrent trials conducted upstream. One trial conducted on March 4, 2009 was excluded for failing to meet the minimum of 7 recaptures. There was no second trial conducted during the same week while the RST was fishing at half cone. Since the flows for this week did not fluctuate significantly, the season average for half cone was used for the week's efficiencies.

The number of individual fish marked for each trial ranged from 144-800, with an average of 413. Recaptured fish numbers per trial ranged from 6-49 with an average of 27. Efficiencies ranged from 1.4% to 12.6% per trial, with an average of 6.6% (Table 11).

Due to low fish collection numbers, we were unable to conduct mark and recapture studies from November 14 until December 19, 2008. As described in the methods, for the period from November 14 through December 18, 2008 (weeks 46-51), May 14- July 2, 2009 (weeks 20-27), we substituted the "season" efficiency. The seasonal efficiency was calculated by dividing the average number of fish released (383) of the 29 trials used, by the average number of recaptures (31). Therefore, the seasonal average was 8.3% (31+1/383+1).

Mortality

Marking mortality—A total of 51 mortalities occurred among the 12,390 marked Chinook salmon, for a total marking mortality (= total marking mortalities / total number of fish released = 40/12,390) of 0.3%. Mortalities resulting from our marking procedures for each efficiency trial ranged from 0 – 3.4%. All mortalities were incidental and no significant marking mortalities occurred (Table 8 and Table 10). Three mortalities occurred among the 445 marked steelhead / rainbow trout, for a total marking mortality of 0.7%.

Trapping mortality—A total of 1,434 mortalities for all runs of Chinook salmon and steelhead / rainbow trout occurred as a result of RST sampling for BY 2008.

Upper Clear Creek spring-run Chinook salmon—There were 11,621 BY 2008 SCS captured in the UCC RST. Of these captures 28 were recorded as mortalities generating a 0.2% mortality rate of fish handled and a 0.03% mortality rate of the total passage index of 96,166. (Table 12).

Lower Clear Creek late-fall-run Chinook salmon—There were 2,537 BY 2008 LFC captured in the LCC RST. Of these captures 15 were recorded as mortalities generating a 0.6% mortality rate of fish handled and a 0.03% mortality rate of the total passage index of 45,903 (Table 13).

Winter-run Chinook salmon—There were 91 WCS (according to length-at-date criteria) captured in the LCC RST. Seven of the 91 Chinook indexed to have passed were actually captured; the other 84 were derived from proportional extrapolation of capture data. The extrapolation catch data is used to assign fish a run when they are enumerated, but not measured for run assignment. The enumerated fish are proportionately assigned a run based on the sub-sample run assignment (i.e. if 25 of 100 measured Chinook are WCS and 1000 Chinook were only enumerated, 250 would be assigned WCS). The passage index was 1,120. No WCS mortalities were recorded.

Spring-run Chinook salmon—There were 2,665 BY 2008 SCS captured in the lower Clear Creek RST. Of these captures 4 were recorded as mortalities generating a 0.2% mortality rate of fish handled and a 0.005% mortality rate of the total passage index of 80,224 (Table 14).

Fall-run Chinook salmon—There were 324,350 BY 2008 FCS captured in the LCC RST. Of these captures 1,306 were recorded as mortalities generating a 0.4% mortality rate of fish handled and a 0.015% mortality rate of the total passage index of 8,495,024 (Table 15).

Steelhead / rainbow Trout—There were 18 BY 2008 and 2,080 BY 2009 Steelhead trout captured in the LCC RST. Broodyear 2008 had one mortality and BY 2009 had 17.

Discussion and Recommendations

Sampling effort—Funding from the CALFED Bay Delta Program for this project was suspended on December 18, 2008 due a statewide freeze on bond funding. This lack of funding resulted in loss and an inability to replace staff. The UCC trapping season was shortened after we felt that the overall estimate of spring Chinook passage would not be impacted by more than 5%.

The flow conditions during the BY2008 season were excellent for out-migrant sampling. There were three missed sampling days at the UCC RST and those days did not occur until mid-February, well after the peak of SCS out-migration. There was no interpolation for missed sampling days because of the low catch occurring that time of year. In previous years (2003-2007), 96-99.5% of passage has occurred by the end of February. The LCC RST missed 21 sampling days, 9 to high flows and 12 to staffing shortage. The missed sampling days accounted for 9.1% of the total sampling time and 8.5% of the FCS passage data. The LFCS data had 14% of missed sampling days and 12.2% of its passage data interpolated. The steelhead BY2009 missed 11.5% of sampling days and interpolated 6.4% of the passage data.

Upper Clear Creek spring-run Chinook salmon abundance—We have estimated a SCS JPI for the past 6 years. The BY 2008 estimate had two differences from other years: 1) the highest percentage of redds occurring between the weir and the UCC RST (21%) and; 2) the high number of juveniles captured on the first day of trapping. The first 5 years of sampling averaged 95% of redds above the UCC RST. In 2008, 79% of redds were above the UCC RST. Adjusting the 2008 JPI for the 21% of redds located downstream of the trap yields 121,622 juveniles. In 2008, the JPI decreased by 7.7% from the previous cohort of 2005. After adjusting for redds located downstream of UCC, the JPI increased by 12.7% from the cohort of 2005 (Figure 23).

On the first day of trapping, we captured 70 juvenile SCS. This is the most juveniles captured on a first day to date. We attribute our capture to miscalculating our expected fry emergence. Our typical calculation would estimate redd creation from the date first observed and begin totaling temperature units from 7 days prior. In 2008, there was 21 days in between surveys instead of the usual 14. We should have begun calculating temperature units at 11 days (at a minimum) prior the theoretical half of 21 days. Additionally, there was a pulse flow of 600 cfs in the days leading up to the first sampling day, this may have displaced juveniles from redds, and moved them downstream earlier than natural emigration would.

Recommendation 1: We recommend identifying an alternative location for the UCC RST that is in close upstream proximity to the lower separation weir site at rm 7.5. This would allow for a more accurate JPI and eliminate the adjustment for downstream redds.

Recommendation 2: We recommend adjusting the temperature unit analysis to use the maximum number of days between spawning surveys rather than the middle to estimate first fry capture.

Lower Clear Creek late-fall-run Chinook salmon abundance —The BY 2008 late-fall JPI increased by 125% increase from BY 2005. Although, last year's adults were both 3 and 4 year old fish. All of the coded-wire tags were found to be three-year-old spawners in 2008. There was a decrease in the number of adult LFC observed in 2008 (50), from those of 2005(94). It is likely that the number of LFC juveniles generated by length-at-date tables is over or underestimated by the large number of FCS juveniles present and the lack of differentiation between the two runs in late-March and early-April.

Recommendation 3: We recommend using an analysis of expected emergence timing for LFC based on 1,850 daily temperature units to emergence to determine the emergence date of LFC fry. Using a temperature-based analysis will allow for more accurate run classification and associated passage indices.

Recommendation 4: We recommend continuing to take genetic samples of all captures identified as WCS and LFC to verify their run origin and assist in generating more accurate JPI's.

Lower Clear Creek winter-run Chinook salmon abundance —As previously reported (Earley et al. 2009) we do not believe there is a self-sustaining population of WCS in Clear Creek. The estimate of passage of 1,120 is expanded from the capture of seven individuals. All captures were likely sub-yearling LFC captured in the winter of 2008-09. All WCS are genetically sampled and ideally, the analysis results will verify that they are not WCS.

Lower Clear Creek spring-run Chinook salmon abundance —The SCS JPI is only provided here as a comparison to the estimate by the UCC RST. Based on the results, the LCC RST would have estimated approximately 66% of the passage from the UCC RST.

Lower Clear Creek fall-run Chinook salmon abundance —The FCS JPI of 8,451,186 is the second highest recorded since trapping began in 1998. Escapement of adult FCS was 7,677, which is 88% of the average escapement since restoration began in Clear Creek in 1995. Based on the estimate of the 2005 cohort, survival to escapement was estimated to be .26%. The 2008 estimate suggests successful spawning and survival to emergence. The number of juveniles per female is above average (Table 18), and consistent with the previous year.

Lower Clear Creek steelhead / rainbow trout abundance—steelhead / rainbow trout present in Clear Creek exhibit characteristics of a winter-run steelhead, with adults migrating upstream in the late fall and winter and most fry outmigration beginning in late January or early February and peaking during the months of April and May. The 2009 redd count for adult steelhead was the highest on record, however the juvenile production per redd decreased by 60%. We anticipated that with 399 redds we would estimate passage to be approximately 80,000 juveniles based on our average (2001-08) productivity of 200 juveniles per redd. Conversely, we estimated 77 juveniles per redd. High flow events that occurred after February 23 may have scoured redds or displaced juveniles undetected by our trapping. Alternatively, many juveniles may have chosen a different rearing strategy and stayed in freshwater as opposed to migrating to the delta or Pacific Ocean. If the latter rearing strategy occurred than it would be difficult to measure the spawning success in the population.

Recommendation 5: We recommend continuing to pursue otolith microchemistry studies to identify the proportion of juveniles that rear outside of Clear Creek.

Genetic and otolith sampling—Genetic samples of juvenile Chinook salmon are analyzed by the Oregon State University's Hatfield Marine Lab in Newport, Oregon, by Dr. Michael Banks. At the time of this report samples collected during the 2008-2009 sampling seasons have not yet been analyzed. We are hoping that advances in the technology used for genetic analysis will continue to improve and assist us in refining our passage indices. Additionally, we hope to develop a Clear Creek genetic baseline from Chinook spawning in Clear Creek.

We collected steelhead / rainbow trout otolith samples for analysis of strontium to calcium ratios to assist in identifying the proportion of juveniles that are of anadromous maternal lineage. Identifying these individuals may allow us to apply anadromous lineage to a proportion of the total *O. mykiss* captures and develop an anadromous and resident estimate. We currently have no other method for determining the proportion of steelhead / rainbow trout that are anadromous. At the time of this report, the otolith data has not been analyzed.

Mark and recapture efficiency estimates

Upper Clear Creek—The results of mark and recapture trials for the UCC were consistent with all other years (except 2006) ranging from 8-12%. There were no significant flow events that occurred during the SCS migration from the upper watershed. Mark and recapture trial flows and results were optimal for determining gear efficiency and SCS JPI.

Lower Clear Creek—The trials conducted for FCS using Chinook were successful. We also had an opportunity to conduct steelhead efficiency trials. During early March 2009, during the onset of outmigration, we were seeing larger (200-400) weekly catches of juvenile STT than in previous years. This appeared to be consistent with the number of redds we had observed. We then sought the approval of the California Department of Fish and Game and NOAA Fisheries to conduct mark and recapture trials with STT. After we were authorized to conduct those studies (April 14, 2009) the number of juveniles dropped off significantly. We were able to complete 3 trials between April 20 and 29, and the efficiencies ranged from 4.4-6.1%. Because we were never able to conduct as many trials as necessary to apply to the entire season‘s passage results, we applied the Chinook values. The initial STT trials were paired with Chinook and resulted in lower efficiencies (5.4%) on average, than those of the Chinook (8.3%).

Mortality

Marking mortality—We recorded only 51 mortalities of 20,342 marked fish at both trapping sites. We have been successful in conducting marking activities earlier in the day when ambient temperature is not as much of a stress factor. We will continue to utilize these practices during marking activities.

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Tables

Table 1. The 2008 Clear Creek snorkel survey reach number and location and river miles. In August 2008, the Clear Creek picket weir was placed instream at river mile 7.4. The weir was placed at the Shooting Gallery site due to the observation of 68 adult Chinook in August 2008, between the upstream weir site at RM 8.1 and RM 7.4.

Reach	River Mile	Location
1	18.1 - 15.9	Whiskeytown Dam to Need Camp Bridge
2	15.9 - 13.0	Need Camp Bridge to Kanaka Creek
3	13.0 - 10.9	Kanaka Creek to Igo Gauge
4	10.8 - 8.5	Igo Gauge to Clear Creek Road Bridge
5a1	8.5 - 8.1	Clear Creek Road Bridge to Reading Bar Picket Weir Site
5a2	8.1 - 7.4	Reading Bar Picket Weir Site to Shooting Gallery Picket Weir Site
5b	7.4 - 6.5	Shooting Gallery Picket Weir Site to Old McCormick-Saeltzer Dam Site
6	6.5 - 1.7	Old McCormick-Saeltzer Dam Site to USFWS Lower Rotary Screw Trap

Table 2. Dates with corresponding week numbers for rotary screw trap operations at river mile 1.7 and 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from October 1, 2008 through June 30, 2009.

Dates	Corresponding Week	Dates	Corresponding Week
09/30-10/06	40	04/02-04/08	14
10/07-10/13	41	04/09-04/15	15
10/14-10/20	42	04/16-04/22	16
10/21-10/27	43	04/23-04/29	17
10/28-11/03	44	04/30-05/06	18
11/04-11/10	45	05/07-05/13	19
11/11-11/17	46	05/14-05/20	20
11/18-11/24	47	05/21-05/27	21
11/25-12/01	48	05/28-06/03	22
12/02-12/08	49	06/04-06/10	23
12/09-12/15	50	06/11-06/17	24
12/16-12/22	51	06/18-06/24	25
12/23-12/31	52	06/25-07/01	26
01/01-01/07	1	07/02-07/08	27
01/08-01/14	2	07/09-07/15	28
01/15-01/21	3	07/16-07/22	29
01/22-01/28	4	07/23-07/29	30
01/29-02/04	5	07/30-08/05	31
02/05-02/11	6	08/06-08/12	32
02/12-02/18	7	08/13-08/19	33
02/19-02/25	8	08/20-08/26	34
02/26-03/04	9	08/27-09/02	35
03/05-03/11	10	09/03-09/09	36
03/12-03/18	11	09/10-09/16	37
03/19-03/25	12	09/17-09/23	38
03/26-04/01	13	09/24-09/30	39

Table 3. Weekly summaries of passage indices with 90% and 95% confidence intervals and standard deviation (SD) of the weekly strata of Broodyear 2008 spring-run Chinook salmon captured at the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from November 14, 2008 through February 18, 2009.

Days Sampled	Week	Date	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
4 of 7	Week 46	11/11/08	738	777	984	1,230	1,303	145
7 of 7	Week 47	11/18/08	2,243	2,282	2,891	3,613	3,826	420
7 of 7	Week 48	11/25/08	8,539	8,988	11,385	14,638	15,525	1,703
7 of 7	Week 49	12/02/08	12,220	12,760	15,494	18,862	19,719	1,954
	Week 50 Pt.I	12/09/08	5,478	5,700	6,804	8,271	8,609	781
4 of 7	Week 50 Pt.II	12/12/08	7,116	7,220	8,896	11,070	11,585	1,157
3 of 7	Week 51 Pt.I	12/16/08	4,105	4,218	5,132	6,158	6,551	614
4 of 7	Week 51 Pt.II	12/19/08	7,037	7,367	9,067	10,964	11,787	1,179
3 of 7	Week 52 Pt.I	12/23/08	5,880	6,005	7,840	10,080	10,453	1,227
3 of 7	Week 52 Pt.II	12/26/08	5,730	5,942	8,444	11,460	13,369	1,971
3 of 7	Week 52 Pt.III	12/29/08	2,584	2,751	3,877	5,330	6,092	859
4 of 7	Week 1 Pt.I	01/01/09	2,943	3,050	3,812	4,793	4,934	542
3 of 7	Week 1 Pt.II	01/05/09	1,794	1,848	2,259	2,837	2,905	293
4 of 7	Week 2 Pt.I	01/08/09	1,073	1,105	1,346	1,646	1,722	164
3 of 7	Week 2 Pt.II	01/12/09	1,113	1,158	1,447	1,867	1,996	223
4 of 7	Week 3 Pt.I	01/15/09	1,150	1,200	1,479	1,840	1,882	192
3 of 7	Week 3 Pt.II	01/19/09	679	690	860	1,080	1,108	116
4 of 7	Week 4 Pt.I	01/22/09	1,142	1,187	1,513	1,892	2,018	226
3 of 7	Week 4 Pt.II	01/26/09	619	640	804	994	1,021	111
4 of 7	Week 5 Pt.I	01/29/09	368	387	479	613	649	70
3 of 7	Week 5 Pt.II	02/02/09	160	164	222	297	312	41
7 of 7	Week 6	02/05/09	153	158	195	245	257	27
4 of 7	Week 7	02/12/09	634	673	936	1,268	1,437	200
				Sampling ended 02/18/09				
		Total	73,500	76,271	96,166	121,048	129,059	

*Week 52 (12/23/08-12/31/08) contains 9 days for keeping Jan. 1 as Julian calendar day 1.

Table 4. Weekly summaries of passage indices with 90% and 95% confidence intervals and standard deviation (SD) of the weekly strata of Broodyear 2008 late-fall-run Chinook salmon captured at the lower rotary screw at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from April 1, 2008 through March 31, 2009. Sampling of late-fall Chinook was not conducted from 7/2/09 – 11/14/2009.

Days Sampled	Week	Date	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
7 of 7	Week 14	04/01/08	1,964	2,077	2,637	3,375	3,600	410
7 of 7	Week 15	04/08/08	3,583	3,745	4,988	6,592	6,867	885
7 of 7	Week 16	04/15/08	4,810	4,970	7,097	9,941	10,651	1,611
7 of 7	Week 17	04/22/08	2,557	2,727	3,900	5,844	6,293	916
7 of 7	Week 18	04/29/08	2,899	2,996	4,279	5,991	6,419	967
7 of 7	Week 19	05/06/08	4,498	4,808	6,639	9,296	9,960	1,432
7 of 7	Week 20	5/13/2008	3,809	4,072	5,618	7,872	8,434	1,247
7 of 7	Week 21	05/20/08	2,166	2,311	3,301	4,621	4,951	751
7 of 7	Week 22	05/27/08	637	658	948	1,316	1,411	213
7 of 7	Week 23	06/03/08	2,569	2,740	3,915	5,872	6,324	921
7 of 7	Week 24	06/10/08	1,014	1,048	1,497	2,096	2,245	338
7 of 7	Week 25	06/17/08	247	264	365	510	547	79
7 of 7	Week 26	06/24/08	299	309	441	618	662	99
				No sampling during this period				
4 of 7	Week 46	11/11/08	9	9	12	16	17	2
7 of 7	Week 47	11/18/08	26	27	40	46	50	6
7 of 7	Week 48	11/25/08	9	9	12	15	17	2
7 of 7	Week 49	12/02/08	9	9	12	16	17	2
7 of 7	Week 50	12/09/08	35	37	50	64	67	8
3 of 7	Week 51	12/16/08	0	0	0	0	0	0
4 of 7	Week 51 Pt:II		0	0	0	0	0	0
3 of 9	Week 52*	12/23/08	86	90	113	142	150	16
6 of 9	Week 52 Pt:II		0	0	0	0	0	0
1 of 7	Week 1	01/01/09	0	0	0	0	0	0
3 of 7	Week 1 Pt:II		0	0	0	0	0	0
3 of 7	Week 1 Pt.III		0	0	0	0	0	0
4 of 7	Week 2	01/08/09	0	0	0	0	0	0
3 of 7	Week 2 Pt.II		0	0	0	0	0	0
4 of 7	Week 3	01/15/09	0	0	0	0	0	0

Days Sampled	Week	Date	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
3 of 7	Week 3 Pt:II		0	0	0	0	0	0
4 of 7	Week 4	01/22/09	0	0	0	0	0	0
3 of 7	Week 4 Pt:II		0	0	0	0	0	0
4 of 7	Week 5	01/29/09	0	0	0	0	0	0
3 of 7	Week 5 Pt.II		0	0	0	0	0	0
7 of 7	Week 6	02/05/09	0	0	0	0	0	0
4 of 7	Week 7	02/12/09	0	0	0	0	0	0
1 of 7	Week 8	02/19/09	0	0	0	0	0	0
3 of 7	Week 8 Pt.II		0	0	0	0	0	0
6 of 7	Week 9	02/26/09	0	0	0	0	0	0
6 of 7	Week 10	03/05/09	0	0	0	0	0	0
7 of 7	Week 11	03/12/09	0	0	0	0	0	0
7 of 7	Week 12	03/19/09	0	0	0	0	0	0
3 of 7	Week 13	03/26/09	0	0	0	0	0	0
4 of 7	Week 13 Pt.II		29	30	39	50	52	6
		Total	39,129	39,999	45,903	53,145	54,452	

*Week 52 (12/23/08-12/31/08) contains 9 days for keeping Jan. 1 as Julian calendar day 1.

Table 5. Weekly summaries of passage indices with 90% and 95% confidence intervals and standard deviation (SD) of the weekly strata of Broodyear 2008 fall-run Chinook salmon captured at the lower rotary screw at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from November 14, 2008 through July 2, 2009.

Days Sampled	Week	Date	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
7 of 7	Week 46	11/11/08	0	0	0	0	0	0
7 of 7	Week 47	11/18/08	0	0	0	0	0	0
7 of 7	Week 48	11/25/08	179	192	255	336	351	45
7 of 7	Week 49	12/02/08	7,418	7,771	10,196	13,600	14,191	1,773
7 of 7	Week 50	12/09/08	13,286	14,235	18,679	24,912	25,995	3,352
3 of 7	Week 51	12/16/08	22,865	23,954	31,439	41,920	43,743	5,580
4 of 7	Week 51 Pt:II		15,772	16,758	21,736	28,728	30,938	3,647
3 of 9	Week 52*	12/23/08	19,337	19,993	25,102	31,042	32,766	3,568
6 of 9	Week 52 Pt:II		49,676	51,663	64,581	80,724	86,106	9,476
1 of 7	Week 1	01/01/09	3,427	3,494	4,455	5,748	5,940	693
3 of 7	Week 1 Pt.II		44,268	46,039	59,027	74,256	79,378	9,157
3 of 7	Week 1 Pt.III		51,010	54,788	77,857	105,664	123,274	17,839
4 of 7	Week 2	01/08/09	56,339	58,157	72,114	87,944	92,454	9,246
3 of 7	Week 2 Pt:II		216,945	222,508	299,233	394,445	433,890	54,977
4 of 7	Week 3	01/15/09	411,390	462,814	740,502	1,234,171	1,481,005	262,783
3 of 7	Week 3 Pt:II		226,649	247,253	362,635	543,957	604,396	97,904
4 of 7	Week 4	01/22/09	173,467	181,728	272,595	424,031	477,035	77,905
3 of 7	Week 4 Pt:II		384,158	395,457	537,821	746,974	790,914	102,566
4 of 7	Week 5	01/29/09	252,788	269,097	362,696	521,375	556,133	77,130
3 of 7	Week 5 Pt:II		166,720	177,476	250,080	366,784	392,983	55,346
7 of 7	Week 6	02/05/09	1,322,840	1,437,870	2,066,934	3,006,455	3,307,101	527,217
4 of 7	Week 7	02/12/09	1,087,073	1,147,466	1,877,671	2,950,628	3,442,399	594,741
1 of 7	Week 8	02/19/09	61,585	68,830	106,374	167,160	195,020	38,809
3 of 7	Week 8 Pt:II		238,685	246,776	309,781	393,507	415,994	47,302
6 of 7	Week 9	02/26/09	269,129	287,071	478,446	717,677	861,213	160,288
6 of 7	Week 10	03/05/09	87,360	90,178	127,061	174,719	186,367	27,306
7 of 7	Week 11	03/12/09	79,427	84,392	117,414	158,855	180,035	24,741
7 of 7	Week 12	03/19/09	51,876	54,989	70,498	91,648	94,808	11,415

Days Sampled	Week	Date	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
3 of 7	Week 13	03/26/09	7,515	7,757	9,619	12,024	12,657	1,333
4 of 7	Week 13 Pt:II		12,857	13,628	17,472	22,714	24,336	2,872
7 of 7	Week 14	04/02/09	8,798	9,157	11,805	14,957	16,025	1,930
7 of 7	Week 15	04/09/09	5,823	5,961	7,829	10,432	10,886	1,324
3 of 7	Week 16	04/16/09	711	729	980	1,292	1,421	185
2 of 7	Week 16 Pt:II		309	321	417	518	554	64
2 of 7	Week 16 Pt:III		173	181	279	403	518	78
3 of 7	Week 17	04/23/09	290	305	471	677	761	129
4 of 7	Week 17 Pt:II		834	856	1,151	1,517	1,669	210
6 of 7	Week 18	04/30/09	2,052	2,137	2,777	3,664	3,800	460
5 of 7	Week 19	05/07/09	4,300	4,495	6,584	9,889	10,988	1,772
2 of 7	Week 19 Pt:II		729	790	1,115	1,723	1,895	280
7 of 7	Week 20	05/14/09	5,821	6,098	8,004	10,245	11,136	1,324
5 of 7	Week 21	05/21/09	4,956	5,198	6,660	8,880	9,266	1,163
5 of 7	Week 22	05/28/09	2,031	2,176	2,856	3,808	3,974	511
5 of 7	Week 23	06/04/09	420	430	564	752	785	97
5 of 7	Week 24	06/11/09	4,678	4,901	6,437	8,233	8,949	1,092
5 of 7	Week 25	06/18/09	375	393	516	660	688	88
5 of 7	Week 26	06/25/09	323	338	444	592	646	80
1 of 7	Week 27	07/02/09	18	18	24	32	35	5
		Total	7,129,073	7,241,051	8,451,186	10,081,615	10,397,719	

*Week 52 (12/23/08-12/31/08) contains 9 days for keeping Jan. 1 as Julian calendar day 1.

Table 6. Weekly passage indices with 90% and 95% confidence intervals, standard deviation (SD) of the weekly strata for BY 2009, steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from January 1, 2009 through July 2, 2009.

Days Sampled	Week	BY2009	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
1 of 7	Week 1	01/01/09	0	0	0	0	0	0
3 of 7	Week1 Pt:II		0	0	0	0	0	0
3 of 7	Week 1 Pt.III		0	0	0	0	0	0
4 of 7	Week 2	01/08/09	0	0	0	0	0	0
3 of 7	Week 2 Pt.II		0	0	0	0	0	0
4 of 7	Week 3	01/15/09	45	48	77	129	154	27
3 of 7	Week 3 Pt:II		50	52	80	120	134	22
4 of 7	Week 4	01/22/09	93	98	146	228	256	40
3 of 7	Week 4 Pt:II		67	71	96	127	142	19
4 of 7	Week 5	01/29/09	165	175	243	329	350	51
3 of 7	Week 5 Pt.II		151	161	220	302	345	50
7 of 7	Week 6	02/05/09	508	530	794	1,155	1,412	247
4 of 7	Week 7	02/12/09	995	1,050	1,719	2,701	3,151	623
1 of 7	Week 8	02/19/09	43	46	75	117	137	24
3 of 7	Week 8 Pt.II		271	280	358	443	467	52
6 of 7	Week 9	02/26/09	445	475	791	1,187	1,425	265
6 of 7	Week 10	03/05/09	418	431	608	836	891	130
7 of 7	Week 11	03/12/09	1,324	1,365	1,899	2,570	2,913	409
7 of 7	Week 12	03/19/09	2,038	2,120	2,718	3,533	3,655	433
3 of 7	Week 13	03/26/09	1,362	1,406	1,743	2,235	2,294	246
4 of 7	Week 13 Pt.II		2,866	2,983	3,748	4,872	5,220	603
7 of 7	Week 14	04/02/09	1,466	1,526	1,968	2,493	2,671	313
7 of 7	Week 15	04/09/09	1,391	1,456	1,956	2,504	2,721	348
3 of 7	Week 16	04/16/09	972	1,022	1,375	1,812	1,993	257
2 of 7	Week 16 Pt.II		975	1,014	1,300	1,636	1,748	198
2 of 7	Week 16 Pt.III		594	624	959	1,386	1,559	270
3 of 7	Week 17	04/23/09	380	399	613	886	997	171
4 of 7	Week 17 Pt.II		469	494	647	853	894	116

Days Sampled	Week	BY2009	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
6 of 7	Week 18	04/30/09	596	633	821	1,085	1,125	144
5 of 7	Week 19	05/07/09	625	682	1,000	1,499	1,666	267
2 of 7	Week 19 Pt.II		108	112	165	234	255	40
7 of 7	Week 20	05/14/09	785	823	1,080	1,440	1,503	191
5 of 7	Week 21	05/21/09	393	402	540	691	751	91
5 of 7	Week 22	05/28/09	279	293	384	512	559	68
5 of 7	Week 23	06/04/09	148	155	204	272	297	37
5 of 7	Week 24	06/11/09	576	603	792	1,056	1,152	145
5 of 7	Week 25	06/18/09	375	393	516	660	718	87
5 of 7	Week 26	06/25/09	593	622	816	1,044	1,135	140
1 of 7	Week 27	07/02/09	27	28	36	48	50	6
			No sampling during this period until 11/2009					
		Total	28,103	28,440	30,487	32,968	33,599	

*Week 52 (12/23/08-12/31/08) contains 9 days for keeping Jan. 1 as Julian calendar day 1.

Table 7. Weekly passage indices with 90% and 95% confidence intervals, standard deviation (SD) of the weekly strata for BY 2008, Age 0+, steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from January 1, 2009 through December 31, 2009.

Days Sampled	Week	BY2008 0+	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
1 of 7	Week 1	01/01/09	0	0	0	0	0	0
3 of 7	Week1 Pt:II		7	8	10	13	14	2
3 of 7	Week 1 Pt.III		0	0	0	0	0	0
4 of 7	Week 2	01/08/09	0	0	0	0	0	0
3 of 7	Week 2 Pt.II		0	0	0	0	0	0
4 of 7	Week 3	01/15/09	0	0	0	0	0	0
3 of 7	Week 3 Pt:II		0	0	0	0	0	0
4 of 7	Week 4	01/22/09	0	0	0	0	0	0
3 of 7	Week 4 Pt:II		0	0	0	0	0	0
4 of 7	Week 5	01/29/09	0	0	0	0	0	0
3 of 7	Week 5 Pt.II		13	13	18	25	29	4
7 of 7	Week 6	02/05/09	0	0	0	0	0	0
4 of 7	Week 7	02/12/09	41	46	75	117	137	27
1 of 7	Week 8	02/19/09	22	23	37	59	69	13
3 of 7	Week 8 Pt.II		13	14	17	22	23	2
6 of 7	Week 9	02/26/09	157	168	279	419	503	105
6 of 7	Week 10	03/05/09	43	45	63	86	99	13
7 of 7	Week 11	03/12/09	0	0	0	0	0	0
7 of 7	Week 12	03/19/09	10	10	13	17	18	2
3 of 7	Week 13	03/26/09	0	0	0	0	0	0
4 of 7	Week 13 Pt.II		0	0	0	0	0	0
7 of 7	Week 14	04/02/09	10	10	13	17	18	2
7 of 7	Week 15	04/09/09	9	9	12	16	17	2
3 of 7	Week 16	04/16/09	0	0	0	0	0	0
2 of 7	Week 16 Pt.II		0	0	0	0	0	0
2 of 7	Week 16 Pt.III		0	0	0	0	0	0
3 of 7	Week 17	04/23/09	0	0	0	0	0	0

Days Sampled	Week	BY2008 0+	95% CI Lower	90% CI Lower	Weekly Passage	90% CI Upper	95% CI Upper	S.D.
4 of 7	Week 17 Pt.II		0	0	0	0	0	0
6 of 7	Week 18	04/30/09	0	0	0	0	0	0
5 of 7	Week 19	05/07/09	0	0	0	0	0	0
2 of 7	Week 19 Pt.II		0	0	0	0	0	0
7 of 7	Week 20	05/14/09	0	0	0	0	0	0
5 of 7	Week 21	05/21/09	0	0	0	0	0	0
5 of 7	Week 22	05/28/09	0	0	0	0	0	0
5 of 7	Week 23	06/04/09	0	0	0	0	0	0
5 of 7	Week 24	06/11/09	0	0	0	0	0	0
5 of 7	Week 25	06/18/09	0	0	0	0	0	0
5 of 7	Week 26	06/25/09	0	0	0	0	0	0
1 of 7	Week 27	07/02/09	0	0	0	0	0	0
				No sampling during this period				
0 of 7	Week 47	11/19/09	0	0	0	0	0	0
0 of 7	Week 48	11/26/09	0	0	0	0	0	0
0 of 7	Week 49	12/03/09	0	0	0	0	0	0
0 of 7	Week 50	12/10/09	0	0	0	0	0	0
0 of 7	Week 51	12/17/09	0	0	0	0	0	0
0 of 8	Week 52*	12/24/09	0	0	0	0	0	0
		Total	398	411	537	716	768	

*Week 52 (12/23/08-12/31/08) contains 9 days for keeping Jan. 1 as Julian calendar day 1.

Table 8. Summary of efficiency test data gathered by using mark-recapture trials with juvenile Chinook salmon at the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from November 14, 2008 through February 18, 2009.

Trial	Mark Date	Release Date	Fish Released	Mortality	% Mortality	Trap Catch	Efficiency
1	5-Dec-08	6-Dec-08	334	0	0.00%	55	16.47%
2	7-Dec-08	8-Dec-08	405	0	0.00%	61	15.06%
3	10-Dec-08	11-Dec-08	404	1	0.25%	55	13.61%
4	14-Dec-08	15-Dec-08	402	3	0.00%	49	12.19%
5	17-Dec-08	18-Dec-08	403	0	0.00%	51	12.66%
6	21-Dec-08	22-Dec-08	419	0	0.00%	35	8.35%
7	24-Dec-08	25-Dec-08	300	0	0.00%	18	6.00%
8	28-Dec-08	29-Dec-08	413	0	0.00%	21	5.08%
9	31-Dec-08	1-Jan-09	428	0	0.00%	43	10.05%
10	3-Jan-09	4-Jan-09	399	0	0.00%	53	13.28%
11	6-Jan-09	7-Jan-09	415	1	0.24%	54	13.01%
12	10-Jan-09	11-Jan-09	401	0	0.00%	39	9.73%
13	13-Jan-09	14-Jan-09	401	2	0.50%	55	13.72%
14	17-Jan-09	18-Jan-09	404	0	0.00%	48	11.88%
15	20-Jan-09	21-Jan-09	408	0	0.00%	39	9.56%
16	24-Jan-09	25-Jan-09	401	0	0.00%	46	11.47%
17	27-Jan-09	28-Jan-09	400	1	0.25%	45	11.25%
18	31-Jan-09	1-Feb-09	404	0	0.00%	50	12.38%
19	3-Feb-09	4-Feb-09	405	3	0.74%	53	13.09%
20	10-Feb-09	11-Feb-09	406	0	0.00%	9	2.22%
	Total		7,952	11	0.14%	879	
	Average of efficiency trials						11.28%

Table 9. Mark and recapture efficiency values used for weekly passage indices of Chinook salmon and steelhead / rainbow trout captured in the upper rotary screw trap at river mile 8.3 by the U.S. Fish and Wildlife Service from November 14, 2008 to February 18, 2009.

Dates	Week	Marks	Recaptures	Efficiency
11/11-12/1	46-48	398	44	11.28%
12/02-12/08	49	334	55	16.72%
12/09-12/11	50	405	61	15.27%
12/12-12/15	50	404	55	13.83%
12/16-12/18	51	402	59	14.89%
12/19-12/22	51	403	51	12.87%
12/23-12/25	52	419	35	8.57%
12/26-12/28	52	300	18	6.31%
12/29-12/31	52	413	21	5.31%
01/01-01/04	1	428	43	10.26%
01/05-01/07	1	399	53	13.50%
01/08-01/11	2	415	54	13.22%
01/12-01/14	2	401	39	9.95%
01/15-01/18	3	403	55	13.86%
01/19-01/21	3	404	48	12.10%
01/22-01/25	4	408	39	9.78%
01/26-01/28	4	401	46	11.69%
01/29-02/01	5	400	45	11.47%
02/02-02/04	5	404	50	12.59%
02/05-02/11	6	405	53	13.30%
02/12-02/18	7	406	9	2.46%

Table 10. Summary of efficiency test data gathered by using mark-recapture trials with juvenile Chinook salmon at the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from December 19, 2008 through May 13, 2009.

Trial	Mark Date	Release Date	Fish Released	Mortality	% Mortality	Trap Catch	Efficiency
1	17-Dec-08	18-Dec-08	402	0	0.00%	36	8.96%
2	21-Dec-08	22-Dec-08	402	0	0.00%	46	11.44%
3	24-Dec-08	25-Dec-08	310	0	0.00%	39	12.58%
4	31-Dec-08	1-Jan-09	395	0	0.00%	38	9.62%
5	3-Jan-09	4-Jan-09	400	0	0.00%	18	4.50%
6	6-Jan-09	7-Jan-09	404	2	0.48%	49	12.13%
7	10-Jan-09	11-Jan-09	402	0	0.00%	28	6.97%
8	13-Jan-09	14-Jan-09	385	0	0.00%	9	2.34%
9	17-Jan-09	18-Jan-09	400	0	0.00%	14	3.50%
10	20-Jan-09	21-Jan-09	409	0	0.00%	13	3.18%
11	24-Jan-09	25-Jan-09	400	0	0.00%	24	6.00%
12	27-Jan-09	28-Jan-09	399	2	0.50%	22	5.51%
13	31-Jan-09	1-Feb-09	402	3	0.74%	21	5.22%
14	3-Feb-09	4-Feb-09	409	4	0.97%	15	3.67%
15	10-Feb-09	11-Feb-09	410	0	0.00%	10	2.44%
16	18-Feb-09	19-Feb-09	800	3	0.37%	46	5.75%
17	25-Feb-09	25-Feb-09	418	0	0.00%	8	1.91%
18	10-Mar-09	11-Mar-09	507	1	0.20%	22	4.34%
19	17-Mar-09	18-Mar-09	511	0	0.00%	38	7.44%
20	24-Mar-09	25-Mar-09	500	0	0.00%	49	9.80%
21	27-Mar-09	28-Mar-09	503	2	0.39%	38	7.55%
22	31-Mar-09	1-Apr-09	491	3	0.61%	37	7.54%
23	14-Apr-09	15-Apr-09	308	1	0.31%	28	9.09%
24	17-Apr-09	18-Apr-09	501	1	0.20%	38	7.58%
25	19-Apr-09	20-Apr-09	144	2	1.37%	12	8.33%
26	24-Apr-09	25-Apr-09	297	4	1.33%	28	9.43%
27	28-Apr-09	29-Apr-09	497	3	0.60%	36	7.24%
28	6-May-09	6-May-09	318	1	0.31%	14	4.40%
29	11-May-09	12-May-09	233	8	3.28%	16	6.87%
	Total		12,390	40	0.32%	792	
	Average of efficiency trials						6.29%

Table 11. Mark and recapture efficiency values used for weekly passage indices of Chinook salmon and steelhead / rainbow trout captured in the lower rotary screw trap at river mile 1.7 by the U.S. Fish and Wildlife Service from November 14, 2008 through July 2, 2009. Darkly shaded rows indicate pooled values where more than one trial was used to determine efficiency. Lightly shaded rows indicate weeks where season efficiency was used.

Dates	Week	Marks	Recaptures	Efficiency
11/14-12/18	48-51	383	31	0.0833
12/19-12/25	51-52	402	36	0.0918
12/26-01/01	52-1	310	39	0.1286
01/02-01/04	1	395	38	0.0985
01/05-01/07	1	400	18	0.0474
01/08-01/11	2	404	49	0.1235
01/12-01/14	2	402	28	0.0720
01/15-01/18	3	385	9	0.0259
01/19-01/21	3	400	14	0.0374
01/22-01/25	4	409	13	0.0341
01/26-01/28	4	400	24	0.0623
01/29-02/01	5	399	22	0.0575
02/02-02/04	5	402	21	0.0546
02/05-02/11	6	409	15	0.0390
02/12-02/19	7-8	410	10	0.0268
02/20-02/25	8	800	46	0.0587
02/26-03/04	9	418	8	0.0215
03/05-03/11	10	460	21	0.0477
03/12-03/18	11	507	22	0.0453
03/19-03/25	12	511	38	0.0762
03/26-03/28	13	500	49	0.0998
03/29-04/01	13	503	38	0.0774
04/02-04/08	14	491	37	0.0772
04/09-04/15	15	383	31	0.0833
04/16-04/18	16	308	28	0.0939
04/19-04/20	16	501	38	0.0777
04/21-04/25	16-17	144	12	0.0897
04/26-04/29	17	297	28	0.0973
4/30-05/06	18	497	36	0.0743
05/07-05/12	19	318	14	0.0470
05/14-07/02	20-27	383	31	0.0833

Table 12. Annual mortality of spring-run Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from November 14, 2008 through February 18, 2009.

Week	Date	Weekly Passage	Catch	Mortality	% Passage	% Catch
No sampling 10/01-11/14/2008						
Week 46	11/11/2008	984	111	11	1.12%	9.91%
Week 47	11/18/2008	2,891	326	3	0.10%	0.92%
Week 48	11/25/2008	11,385	1,284	3	0.03%	0.23%
Week 49	12/2/2008	15,494	2,590	3	0.02%	0.12%
Week 50	12/9/2008	15,700	2,269	5	0.03%	0.22%
Week 51	12/16/2008	14,199	1,931	7	0.05%	0.36%
Week 52*	12/23/2008	20,161	1,411	3	0.01%	0.21%
Week 1	1/1/2009	6,071	696	2	0.03%	0.29%
Week 2	1/8/2009	2,793	322	0	0.00%	0.00%
Week 3	1/15/2009	2,339	309	2	0.09%	0.65%
Week 4	1/22/2009	2,317	242	1	0.04%	0.41%
Week 5	1/29/2009	701	83	0	0.00%	0.00%
Week 6	2/5/2009	195	26	0	0.00%	0.00%
Week 7	2/12/2009	936	23	0	0.00%	0.00%
Sampling ended 02/18/09						

Table 13. Annual mortality of late-fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from April 1, 2008 through March 31, 2009.

Week	Date	Weekly Passage	Catch	Mortality	% Passage	% Catch
Week 14	4/1/2008	2,637	134	0	0.00%	0.00%
Week 15	4/8/2008	4,988	400	1	0.02%	0.25%
Week 16	4/15/2008	7,097	370	2	0.03%	0.54%
Week 17	4/22/2008	3,900	203	2	0.05%	0.99%
Week 18	4/29/2008	4,279	223	0	0.00%	0.00%
Week 19	5/6/2008	6,639	346	5	0.08%	1.45%
Week 20	5/13/2008	5,618	293	2	0.04%	0.68%
Week 21	5/20/2008	3,301	172	0	0.00%	0.00%
Week 22	5/27/2008	948	49	0	0.00%	0.00%
Week 23	6/3/2008	3,915	204	0	0.00%	0.00%
Week 24	6/10/2008	1,497	78	1	0.07%	1.28%
Week 25	6/17/2008	365	19	1	0.27%	5.26%
Week 26	6/24/2008	441	23	1	0.23%	4.35%
		No sampling 07/01-11/10/2008				
Week 46	11/11/2008	12	1	0	0.00%	0.00%
Week 47	11/18/2008	40	3	0	0.00%	0.00%
Week 48	11/25/2008	12	1	0	0.00%	0.00%
Week 49	12/2/2008	12	1	0	0.00%	0.00%
Week 50	12/9/2008	50	4	0	0.00%	0.00%
Week 51	12/16/2008	0	0	0	0.00%	0.00%
Week 52*	12/23/2008	113	13	0	0.00%	0.00%
Week 1	1/1/2009	0	0	0	0.00%	0.00%
Week 2	1/8/2009	0	0	0	0.00%	0.00%
Week 3	1/15/2009	0	0	0	0.00%	0.00%
Week 4	1/22/2009	0	0	0	0.00%	0.00%
Week 5	1/29/2009	0	0	0	0.00%	0.00%
Week 6	2/5/2009	0	0	0	0.00%	0.00%
Week 7	2/12/2009	0	0	0	0.00%	0.00%
Week 8	2/19/2009	0	0	0	0.00%	0.00%
Week 9	2/26/2009	0	0	0	0.00%	0.00%
Week 10	3/5/2009	0	0	0	0.00%	0.00%
Week 11	3/12/2009	0	0	0	0.00%	0.00%
Week 12	3/19/2009	0	0	0	0.00%	0.00%
Week 13	3/26/2009	39	3	0	0.00%	0.00%

Table 14. Annual mortality of spring-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from October 1, 2008 through September 30, 2009.

Week	Date	Weekly Passage	Catch	Mortality	% Passage	% Catch
No sampling 10/01-11/14/2008						
Week 46	11/11/2008	1,278	94	0	0.00%	0.00%
Week 47	11/18/2008	876	68	0	0.00%	0.00%
Week 48	11/25/2008	4,196	339	1	0.02%	0.29%
Week 49	12/2/2008	7,301	603	2	0.03%	0.33%
Week 50	12/9/2008	2,617	215	0	0.00%	0.00%
Week 51	12/16/2008	1,620	132	0	0.00%	0.00%
Week 52*	12/23/2008	1,085	132	0	0.00%	0.00%
Week 1	1/1/2009	97	10	0	0.00%	0.00%
Week 2	1/8/2009	696	50	0	0.00%	0.00%
Week 3	1/15/2009	457	17	0	0.00%	0.00%
Week 4	1/22/2009	84	3	0	0.00%	0.00%
Week 5	1/29/2009	0	0	0	0.00%	0.00%
Week 6	2/5/2009	209	8	0	0.00%	0.00%
Week 7	2/12/2009	58,346	938	0	0.00%	0.00%
Week 8	2/19/2009	1,094	38	0	0.00%	0.00%
Week 9	2/26/2009	569	8	0	0.00%	0.00%
Week 10	3/5/2009	70	7	1	1.43%	14.29%
Week 11	3/12/2009	0	0	0	0.00%	0.00%
Week 12	3/19/2009	0	0	0	0.00%	0.00%
Week 13	3/26/2009	0	0	0	0.00%	0.00%
Week 14	4/2/2009	0	0	0	0.00%	0.00%
Week 15	4/9/2009	0	0	0	0.00%	0.00%
Week 16	4/16/2009	11	1	0	0.00%	0.00%
Week 17	4/23/2009	12	1	0	0.00%	0.00%
Week 18	4/30/2009	0	0	0	0.00%	0.00%
Week 19	5/7/2009	0	0	0	0.00%	0.00%
Week 20	5/14/2009	0	0	0	0.00%	0.00%
Week 21	5/21/2009	0	0	0	0.00%	0.00%
Week 22	5/28/2009	0	0	0	0.00%	0.00%
Week 23	6/4/2009	0	0	0	0.00%	0.00%
Week 24	6/11/2009	0	0	0	0.00%	0.00%
Week 25	6/18/2009	0	0	0	0.00%	0.00%
Week 26	6/25/2009	0	0	0	0.00%	0.00%
No sampling 07/02-09/30/2009						

Table 15. Annual mortality of fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service from October 1, 2008 through September 30, 2009.

Week	Date	Weekly Passage	Catch	Mortality	% Passage	% Catch
No sampling 10/01-11/14/2008						
Week 46	11/11/2008	0	0	0	0.00%	0.00%
Week 47	11/18/2008	0	0	0	0.00%	0.00%
Week 48	11/25/2008	255	21	0	0.00%	0.00%
Week 49	12/2/2008	10,267	850	3	0.03%	0.35%
Week 50	12/9/2008	18,742	1,559	17	0.09%	1.09%
Week 51	12/16/2008	53,175	4,624	27	0.05%	0.58%
Week 52	12/23/2008	89,683	11,240	57	0.06%	0.51%
Week 1	1/1/2009	141,339	10,076	32	0.02%	0.32%
Week 2	1/8/2009	371,347	30,436	80	0.02%	0.26%
Week 3	1/15/2009	1,103,137	32,749	72	0.01%	0.22%
Week 4	1/22/2009	810,416	42,838	63	0.01%	0.15%
Week 5	1/29/2009	612,776	34,507	134	0.02%	0.39%
Week 6	2/5/2009	2,067,728	80,661	38	0.00%	0.05%
Week 7	2/12/2009	1,889,085	31,145	57	0.00%	0.18%
Week 8	2/19/2009	416,155	12,062	425	0.10%	3.52%
Week 9	2/26/2009	483,469	8,928	45	0.01%	0.50%
Week 10	3/5/2009	127,941	5,550	7	0.01%	0.13%
Week 11	3/12/2009	119,689	5,316	5	0.00%	0.09%
Week 12	3/19/2009	73,518	5,370	4	0.01%	0.07%
Week 13	3/26/2009	27,091	2,312	3	0.01%	0.13%
Week 14	4/2/2009	13,758	912	173	1.26%	18.97%
Week 15	4/9/2009	9,161	652	54	0.59%	8.28%
Week 16	4/16/2009	1,676	149	0	0.00%	0.00%
Week 17	4/23/2009	1,622	154	0	0.00%	0.00%
Week 18	4/30/2009	3,020	176	1	0.03%	0.57%
Week 19	5/7/2009	7,699	391	0	0.00%	0.00%
Week 20	5/14/2009	8,796	667	1	0.01%	0.15%
Week 21	5/21/2009	7,254	387	0	0.00%	0.00%
Week 22	5/28/2009	3,111	168	1	0.03%	0.60%
Week 23	6/4/2009	989	33	0	0.00%	0.00%
Week 24	6/11/2009	8,384	355	6	0.07%	1.69%
Week 25	6/18/2009	1,091	31	1	0.09%	3.23%
Week 26	6/25/2009	1,341	27	0	0.00%	0.00%
Week 27	7/2/2009	96	2	0	0.00%	0.00%
No sampling 07/02-09/30/2009						

Table 16. Passage indices of spring-run Chinook salmon with 90% and 95% confidence intervals for Broodyear 2003-2008 captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service. The adjusted population (proportionate to juveniles per redd) includes the redds below the trap and above the separation weir.

Broodyear	2003	2004	2005	2006	2007	2008
95% Lower CI	88,817	87,439	87,516	111,749	92,728	88,834
90% Lower CI	90,113	90,417	89,516	113,659	94,472	89,653
Passage Index	108,338	107,054	104,197	127,197	110,224	96,166
90% Upper CI	130,960	131,700	122,580	144,692	130,585	102,920
95% Upper CI	137,672	136,701	128,418	148,539	135,069	104,402
Adjusted Index	110,422	110,028	106,201	149,318	114,914	121,622
Juveniles per female	7,091	4,682	4,371	2,698	1,771	1,239

Table 17. Passage indices of late-fall run Chinook salmon with 90% and 95% confidence intervals for Broodyear 1999-2008 captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service.

Broodyear	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
95% Lower CI	272,930	90,576	68,446	156,297	29,432	9,570	17,808	70,716	149,395	39,129
90% Lower CI	275,736	92,331	70,733	158,835	30,130	9,915	18,163	72,560	155,897	39,999
Passage Index	292,323	101,347	86,836	172,708	33,902	11,906	20,401	86,918	202,011	45,903
90% Upper CI	310,697	113,299	107,359	189,998	38,705	14,701	22,733	105,130	279,553	53,145
95% Upper CI	314,778	116,274	112,386	192,685	39,638	15,644	23,384	113,960	319,016	54,452

Table 18. Passage indices of fall-run Chinook salmon with 90% and 95% confidence intervals for Broodyear 1998-2008 captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service.

Broodyear	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
95% Lower CI	5,656,571	5,951,440	13,535,844	5,577,387	3,560,468	5,311,235	5,361,896	2,570,162	4,275,282	4,816,781	7,129,073
90% Lower CI	5,760,186	6,009,301	13,681,994	5,602,563	3,609,632	5,406,501	5,465,198	2,609,782	4,359,617	4,906,462	7,241,051
Passage Index	6,395,638	6,405,765	14,955,182	5,788,701	3,858,446	6,056,834	6,190,757	2,969,321	4,929,544	5,545,303	8,451,186
90% Upper CI	7,150,348	6,956,968	16,222,612	6,007,409	4,102,132	6,797,575	6,987,786	3,444,467	5,667,355	6,359,077	10,081,61
95% Upper CI	7,303,438	7,121,563	16,483,244	6,042,987	4,174,685	7,003,322	7,216,897	3,566,470	5,832,272	6,614,700	10,397,71
Passage per adult female	2,573	1,567	4,466	1,031	472	1,114	1,663	309	947	2,105	1,908

Table 19. Passage indices of steelhead / rainbow trout with 90% and 95% confidence intervals for Broodyear 1999-2009 captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service.

Broodyear	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
95% Lower CI	3,986	7,951	8,120	11,731	8,758	24,137	22,247	9,362	27,515	33,284	28,103
90% Lower CI	4,025	8,074	8,226	11,926	8,910	24,697	22,670	9,547	28,349	33,677	28,440
Passage Index	4,229	8,507	8,742	12,803	9,772	28,989	24,791	10,762	33,910	36,499	30,487
90% Upper CI	4,446	9,004	9,311	13,860	10,761	34,454	28,211	12,313	41,428	40,025	32,968
95% Upper CI	4,506	9,162	9,424	14,193	10,954	36,746	29,454	12,632	43,292	40,983	33,599

Table 20. Passage indices of steelhead / rainbow trout with 90% and 95% confidence intervals for Broodyear 1998-2008 Age 0+ captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California, by the U.S. Fish and Wildlife Service.

Broodyear	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
95% Lower CI	603	1,036	Data	838	590	194	468	161	16	209	398
90% Lower CI	609	1,056	not	846	603	198	476	167	16	214	411
Passage Index	655	1,251	reported	884	692	211	560	203	26	255	537
90% Upper CI	709	1,521	at this	928	804	267	672	244	39	307	716
95% Upper CI	724	1,602	time.	939	836	285	712	259	44	329	768

Figures

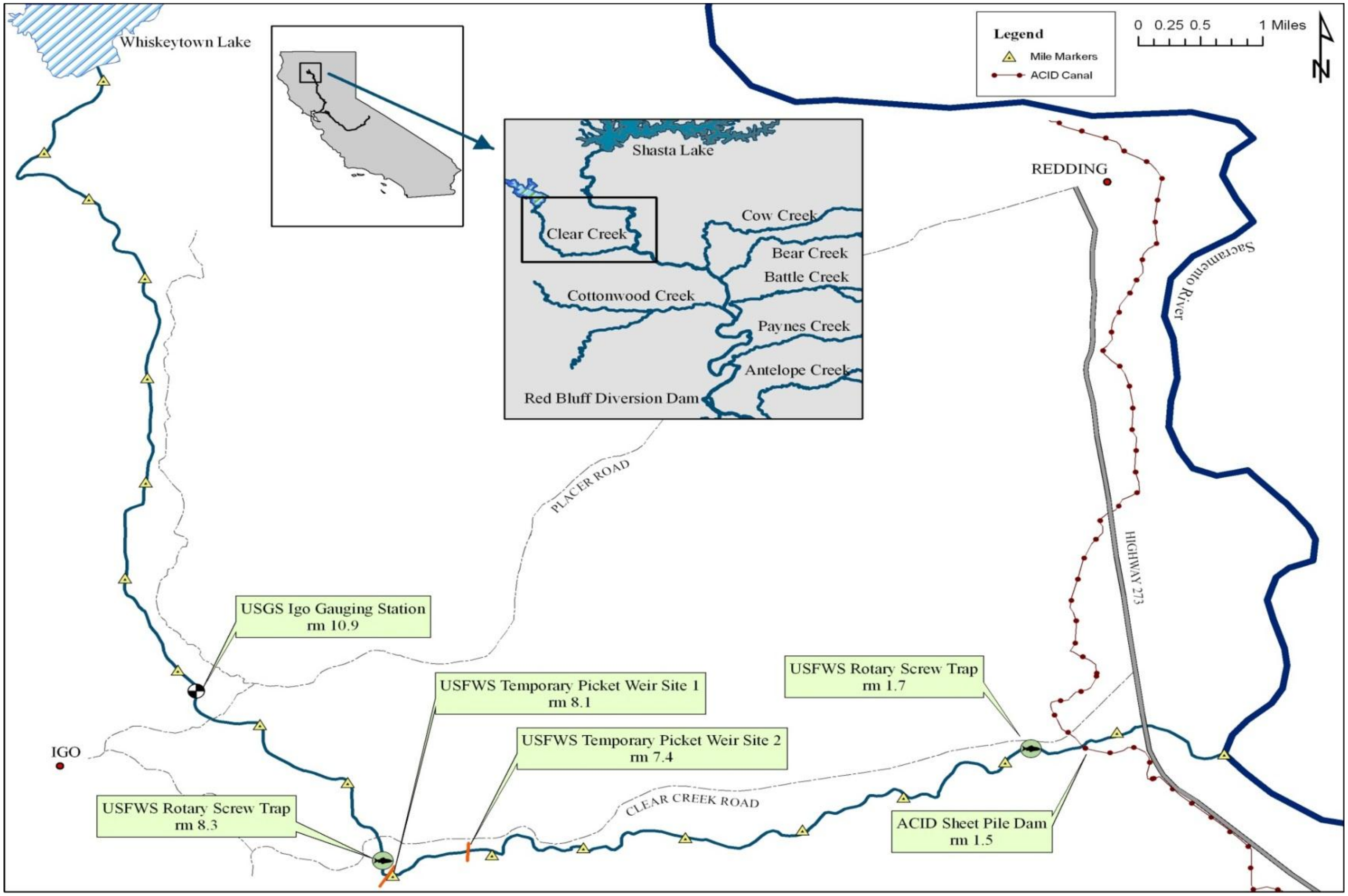

Figure 1. Locations of the upper (UCC) and lower (LCC) rotary screw trap sampling stations used for juvenile salmonid monitoring at river mile 8.3 and 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 26, 2007 through June 30, 2008.

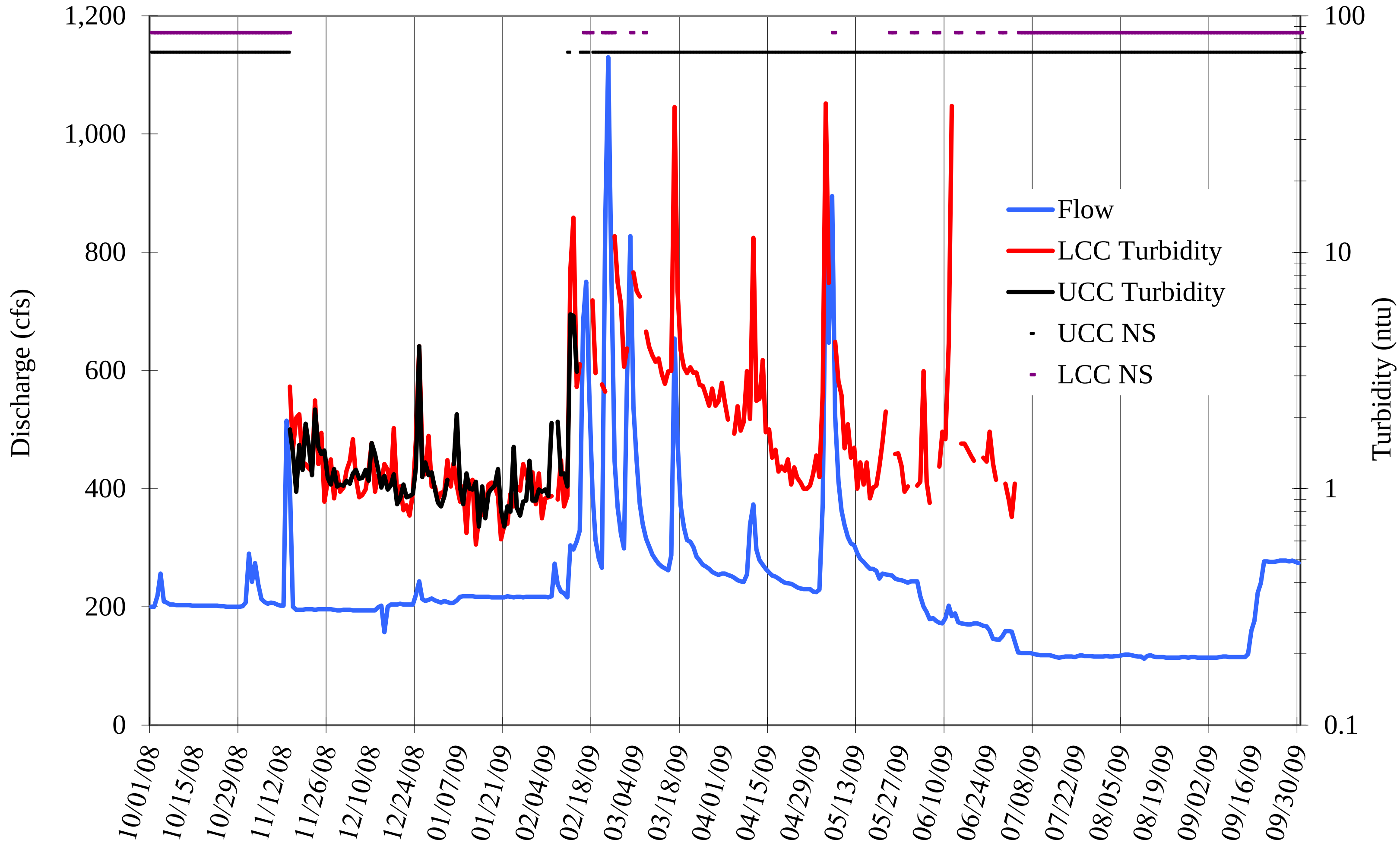

Figure 2. Mean daily flow in cubic feet per second (cfs) measured at the USGS IGO station, non sampling days (NS), and momentary turbidity in nephelometric turbidity units (NTU's) recorded at the upper and lower rotary screw trap sampling stations at river mile 8.3 and 1.7 in Clear Creek, Shasta County, California by the U S. Fish and Wildlife Service from October 1, 2008 through September 30, 2009.

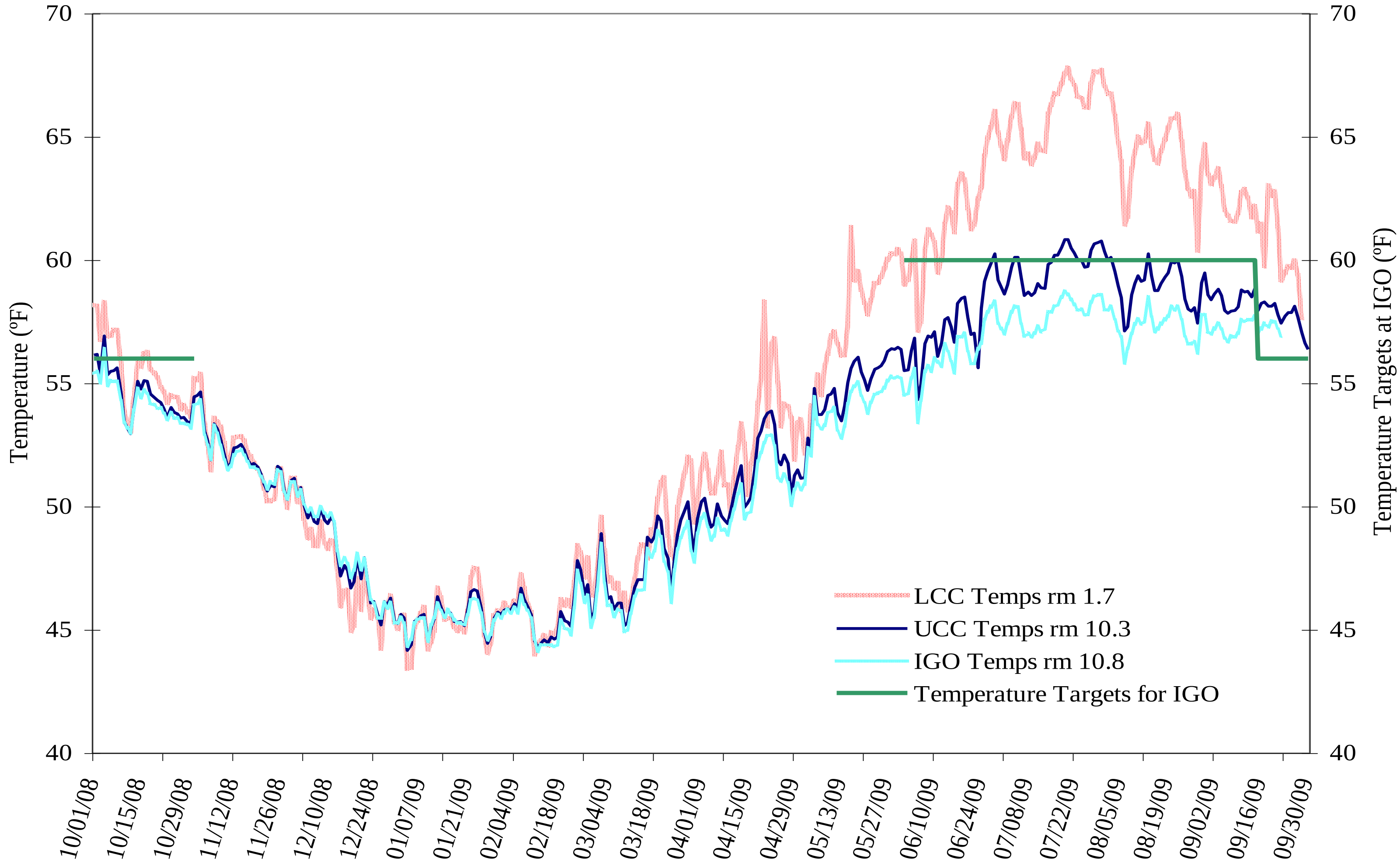

Figure 3. Mean daily water temperatures (°F) recorded at the upper (UCC) and lower (LCC) rotary screw trap sampling stations at river mile 8.3 and 1.7 in Clear Creek, Shasta County, California by the U S. Fish and Wildlife Service from October 1, 2008 through September 30, 2009. Clear Creek Fish Restoration Program temperature targets for fish protection and the temperatures recorded at the Clear Creek IGO gauge are provided for comparison.

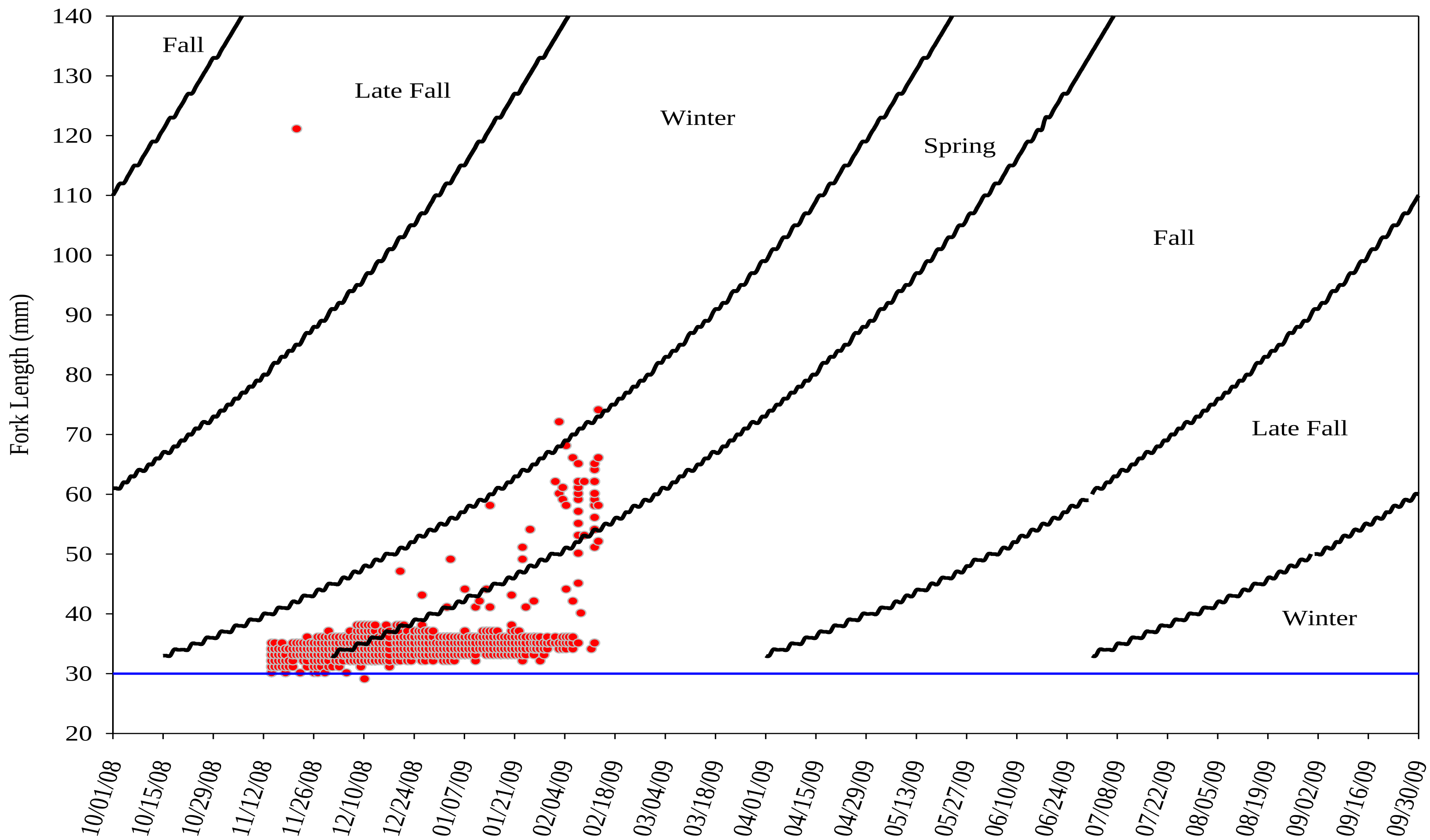

Figure 4. Fork length (mm) distribution by date and run for Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through February 18, 2009. Spline curves represent the maximum fork lengths expected for each run by date, based upon tables of projected annual growth developed by the California Department of Water Resources (Greene 1992).

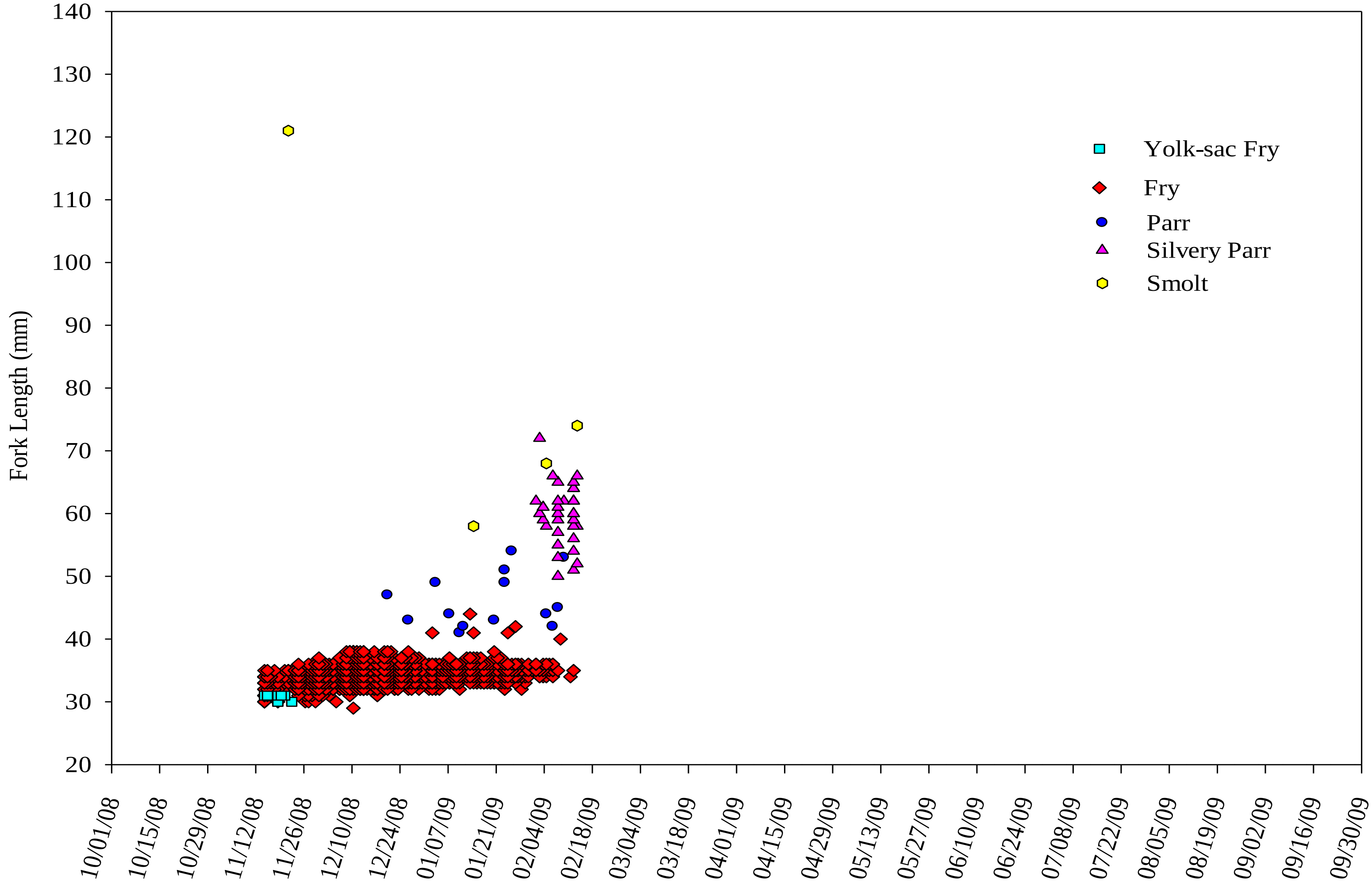

Figure 5. Life stage ratings for BY 2008 juvenile Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through February 18, 2009.

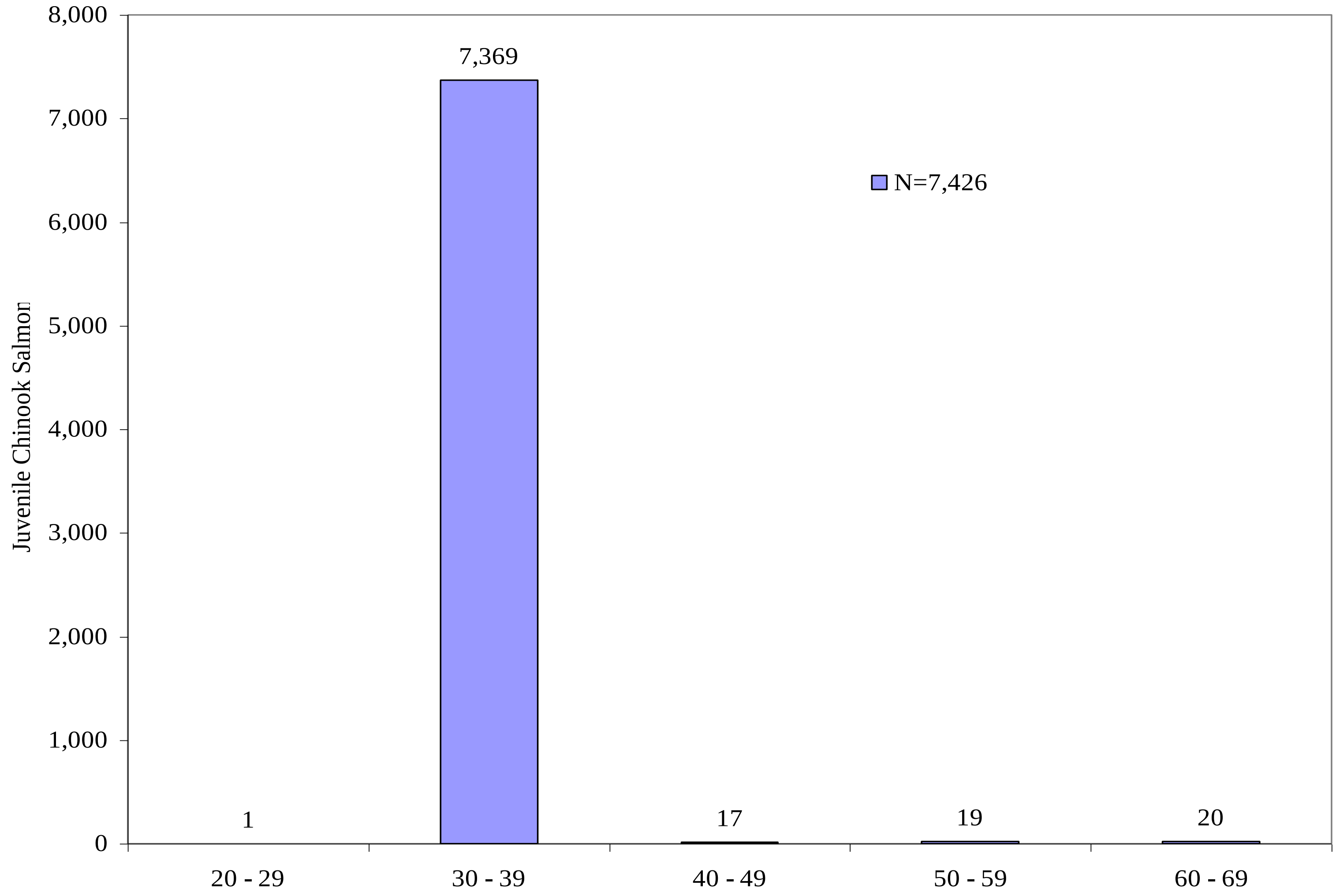

Figure 6. Fork length (mm) frequency distribution of BY 2008 juvenile spring Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through February 18, 2009. Fork length frequencies were assigned based on the proportional frequency of occurrence, in 10 mm increments.

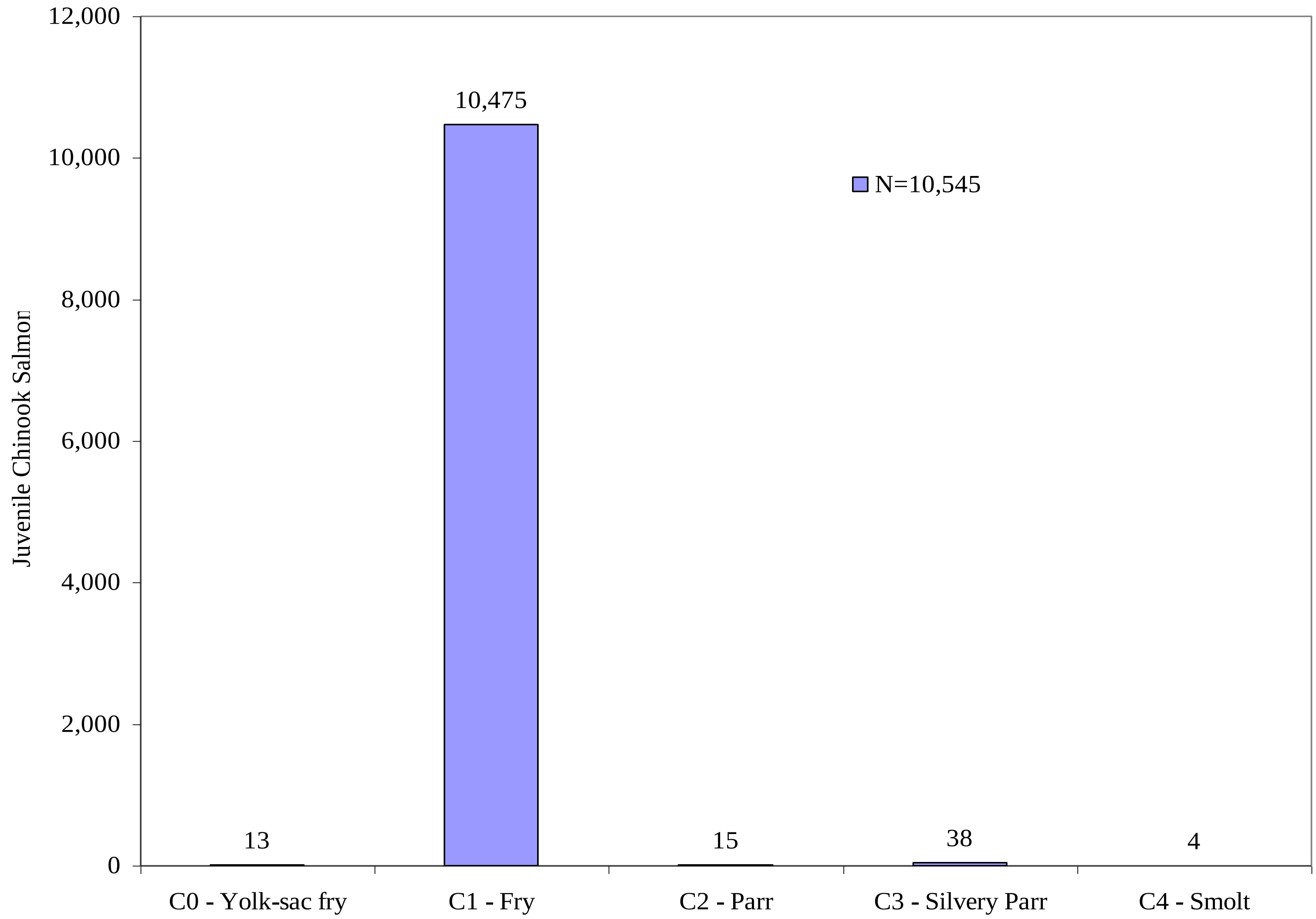

Figure 7. Life stage ratings for BY 2007 juvenile spring-run Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through February 18, 2009.

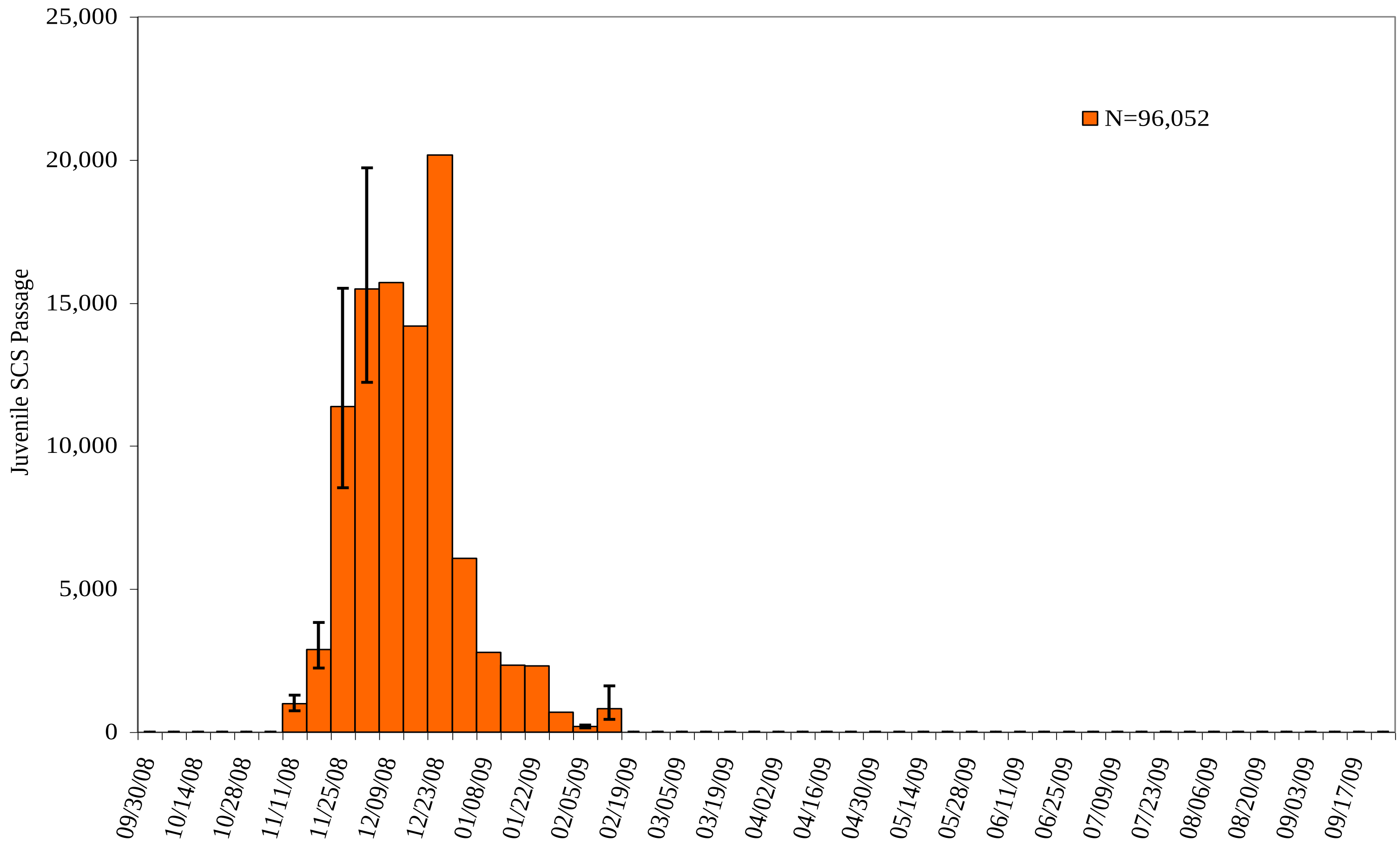

Figure 8. Weekly passage indices with 95% confidence intervals for BY 2008 juvenile spring Chinook salmon captured by the upper rotary screw trap at river mile 8.3 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through February 18, 2009. Spring Chinook passage for Clear Creek is calculated using total catch from the UCC rotary screw trap and weekly trap efficiencies. Weeks without confidence intervals were combined and intervals could not be summed for display.

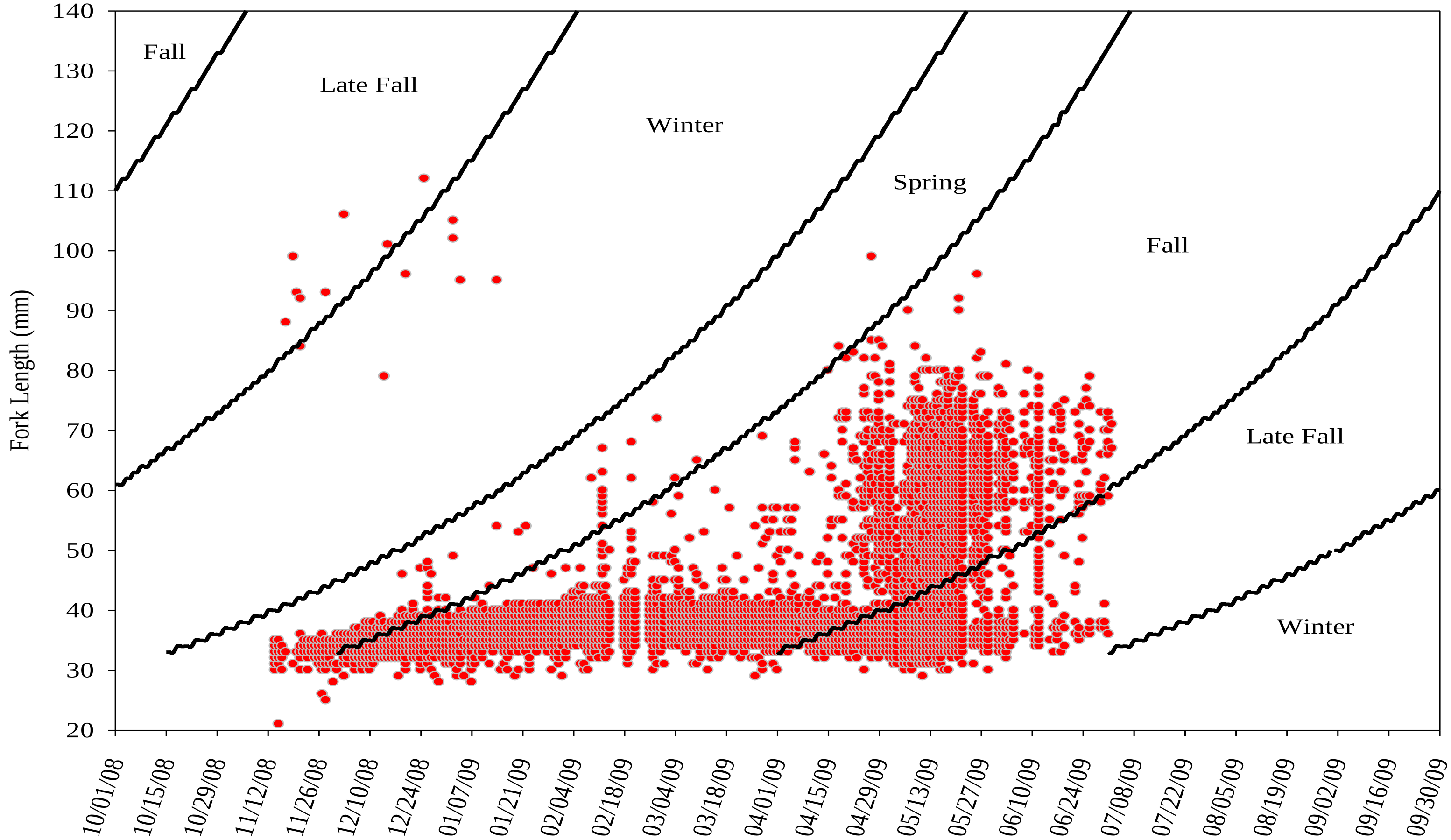

Figure 9. Fork length (mm) distribution by date and run for Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through July 02, 2009. Spline curves represent the maximum fork lengths expected for each run by date, based upon tables of projected annual growth developed by the California Department of Water Resources (Greene 1992).

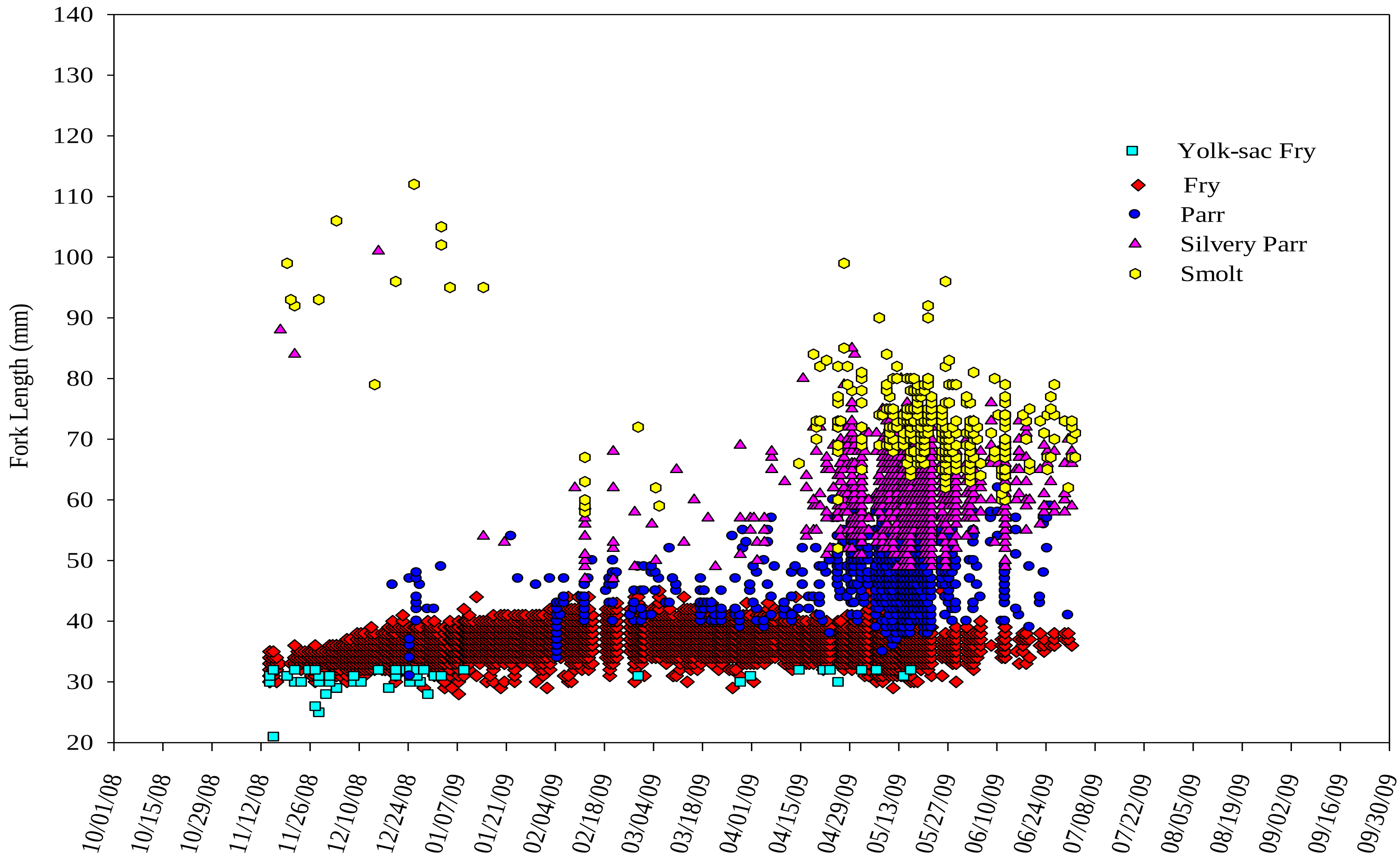

Figure 10. Life stage ratings and forklength distribution for BY 2008 juvenile Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through July 02, 2009.

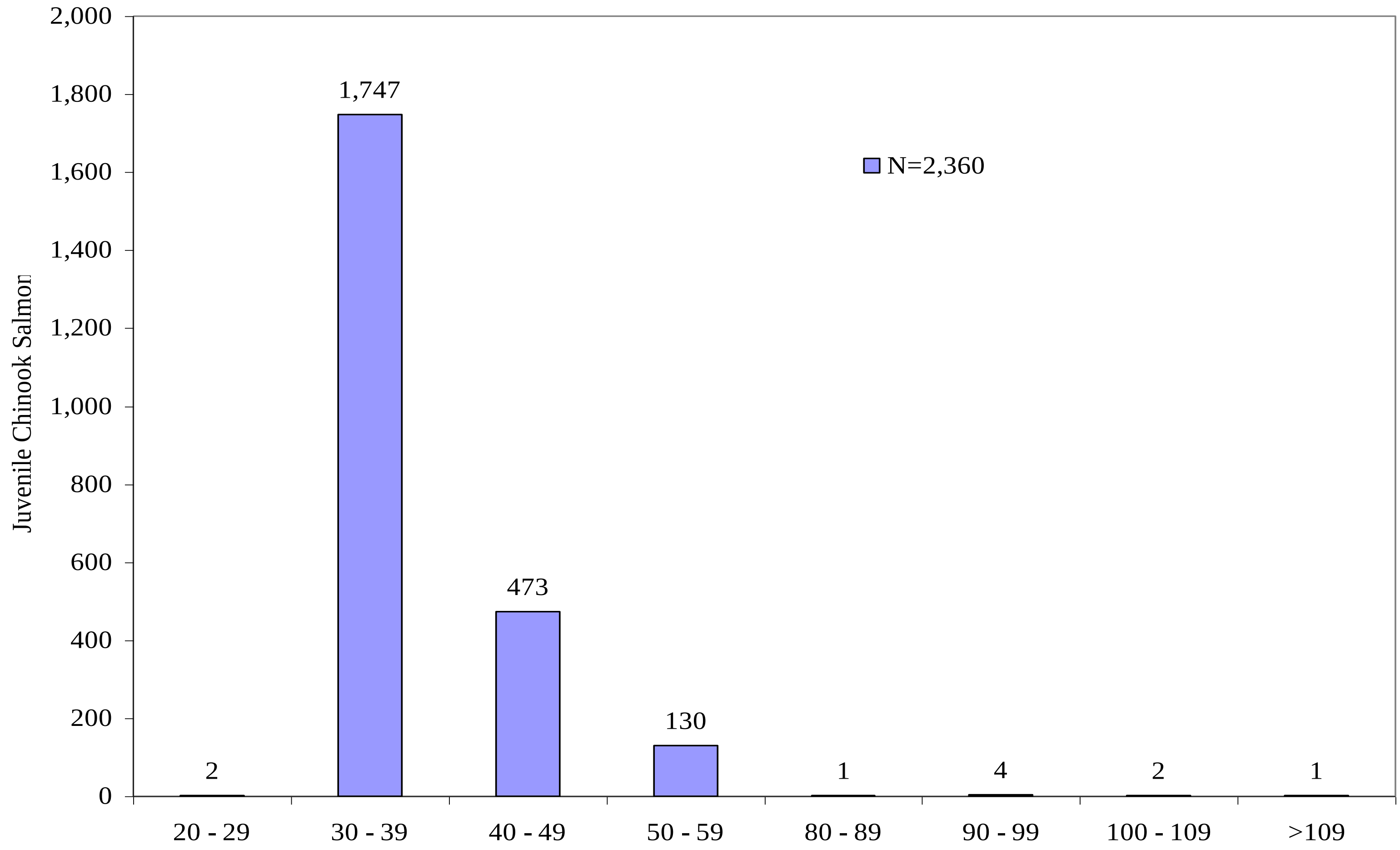

Figure 11. Fork length (mm) frequency distribution of BY 2008 juvenile late fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from April 1, 2008 through March 31, 2009. Fork length frequencies were assigned based on the proportional frequency of occurrence, in 10 mm increments.

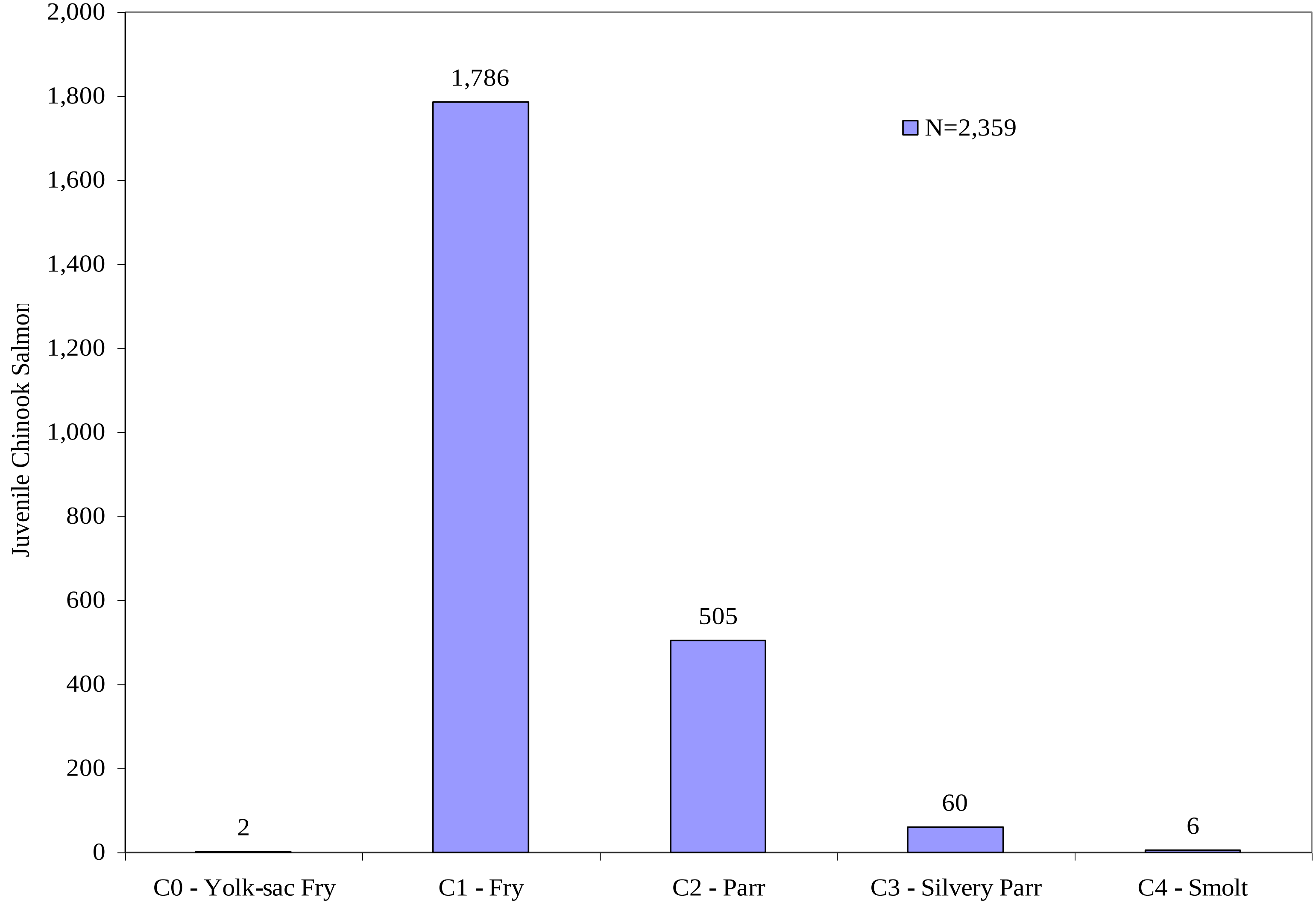

Figure 12. Life stage ratings for BY 2008 juvenile late fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from April 1, 2008 through March 31, 2009.

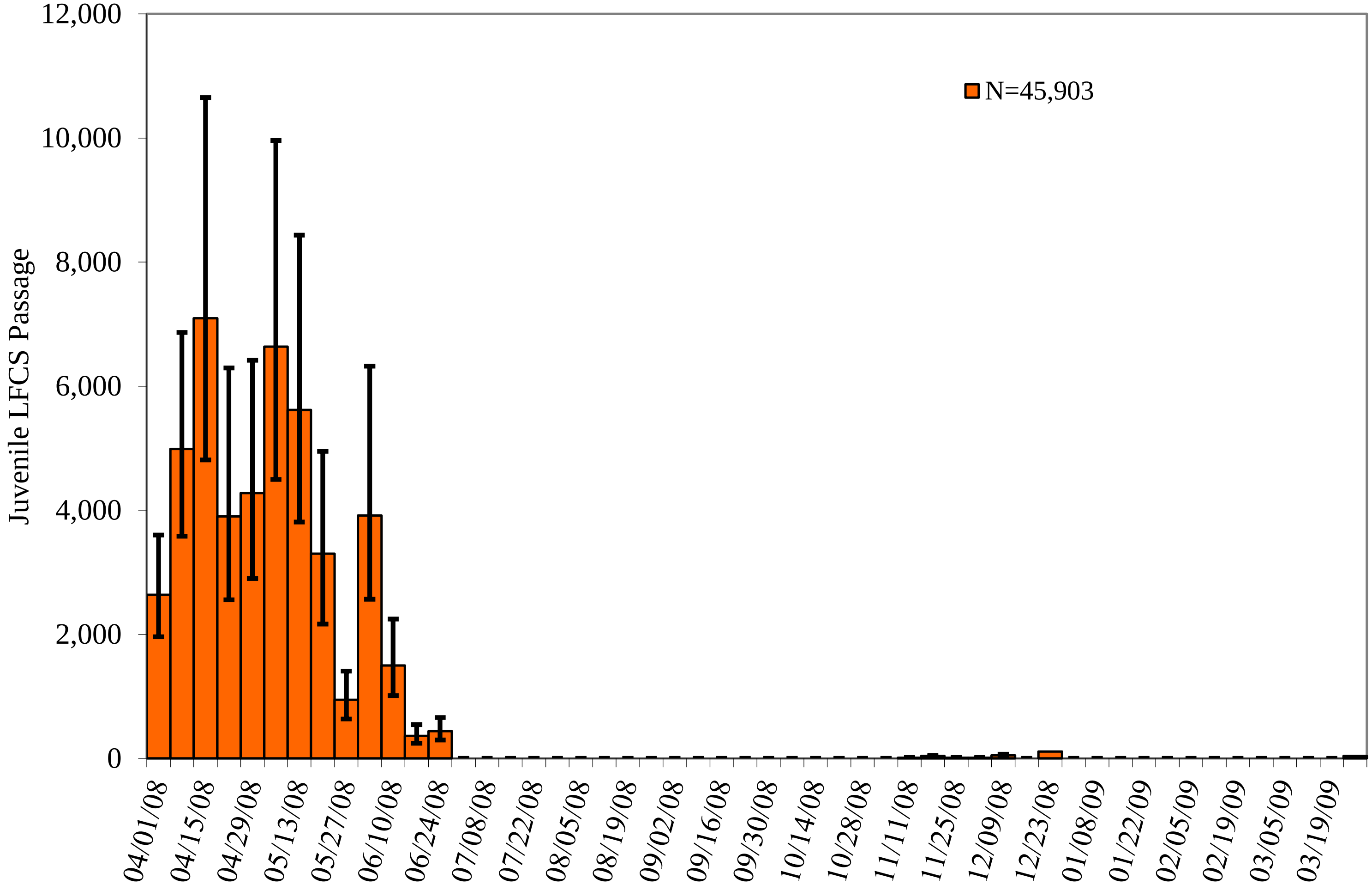

Figure 13. Weekly passage index with 95% confidence intervals of BY 2008 juvenile late-fall run Chinook captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from April 1, 2008 through March 31, 2009. Weeks without confidence intervals were combined and intervals could not be summed for display.

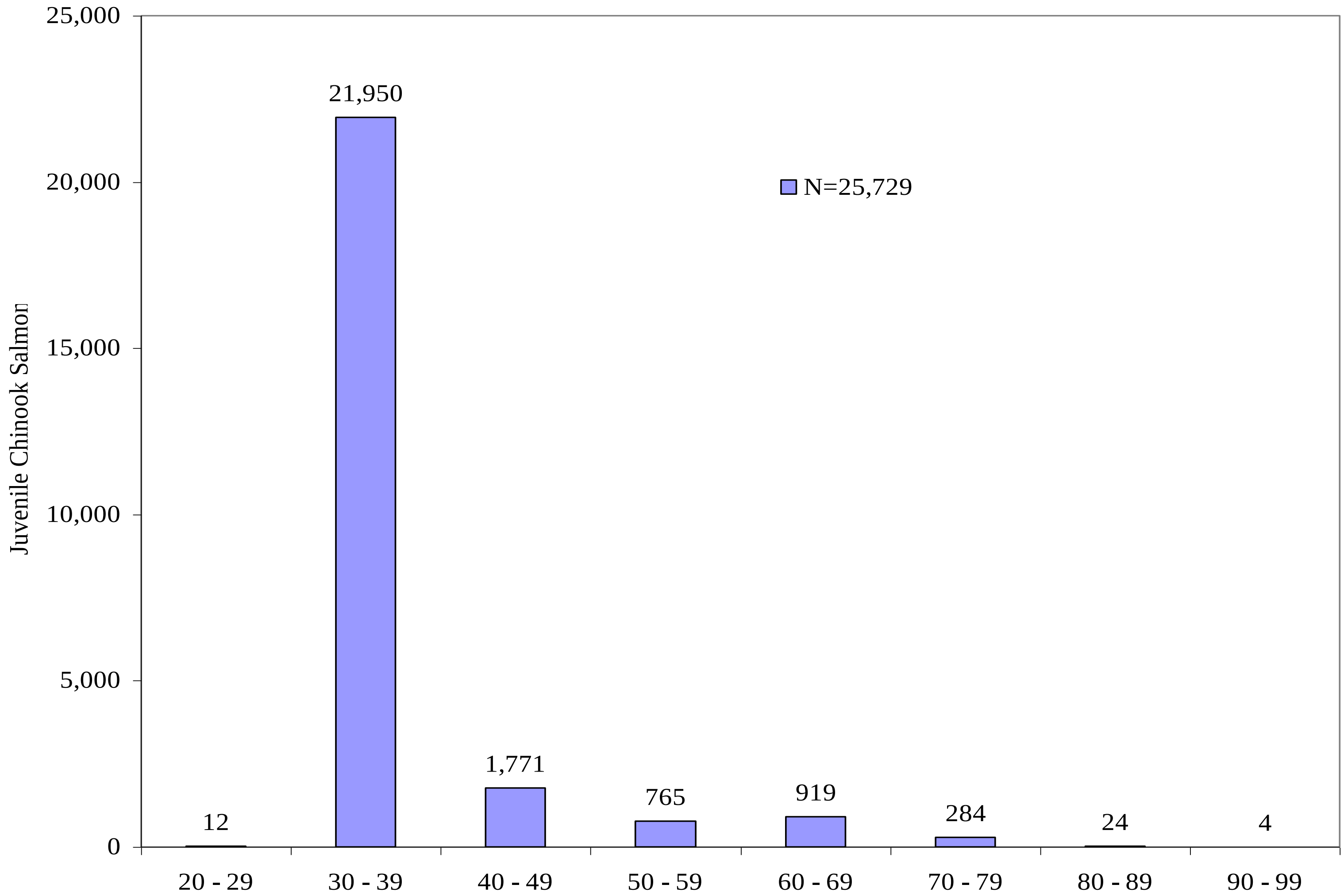

Figure 14. Fork length (mm) frequency distribution of BY 2008 juvenile fall-run Chinook salmon captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through July 02, 2009. Fork length frequencies were assigned based on the proportional frequency of occurrence, in 10 mm increments.

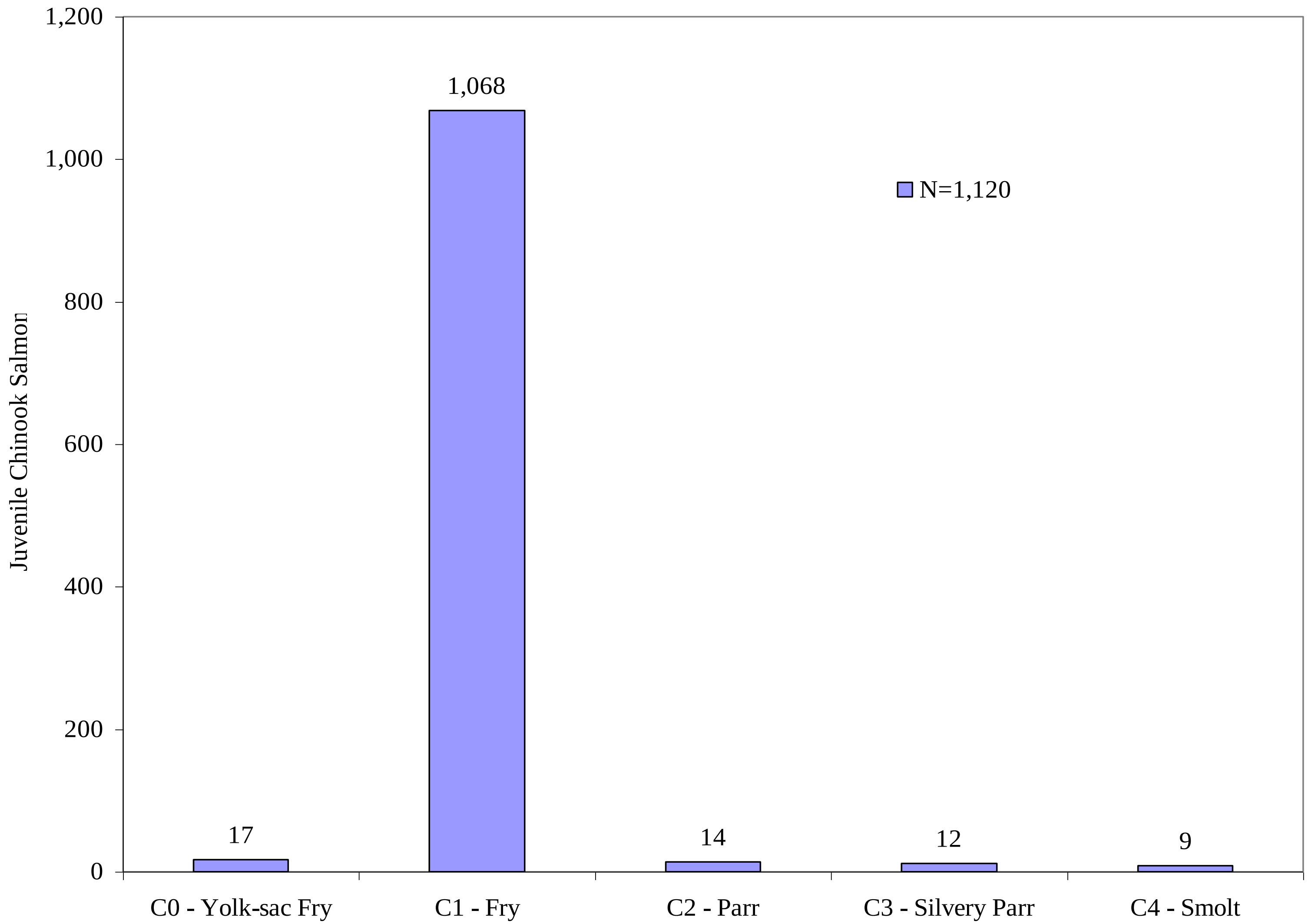

Figure 15. Life stage ratings for juvenile BY 2008 fall-run Chinook salmon by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through July 02, 2009.

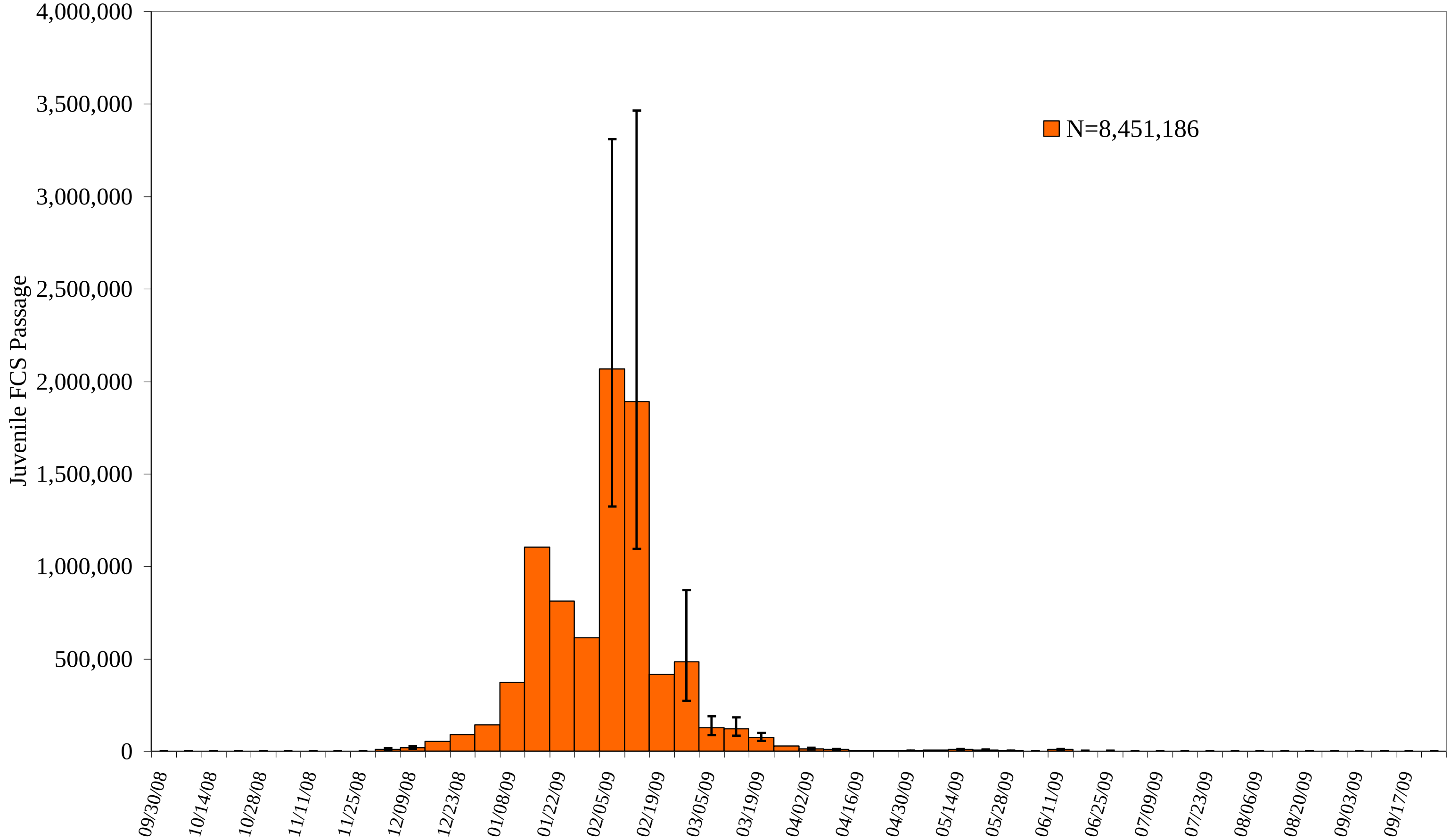

Figure 16. Passage index with 95% confidence intervals of BY 2008 juvenile fall-run Chinook captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from November 14, 2008 through July 02, 2009. Weeks without confidence intervals were combined and intervals could not be summed for display.

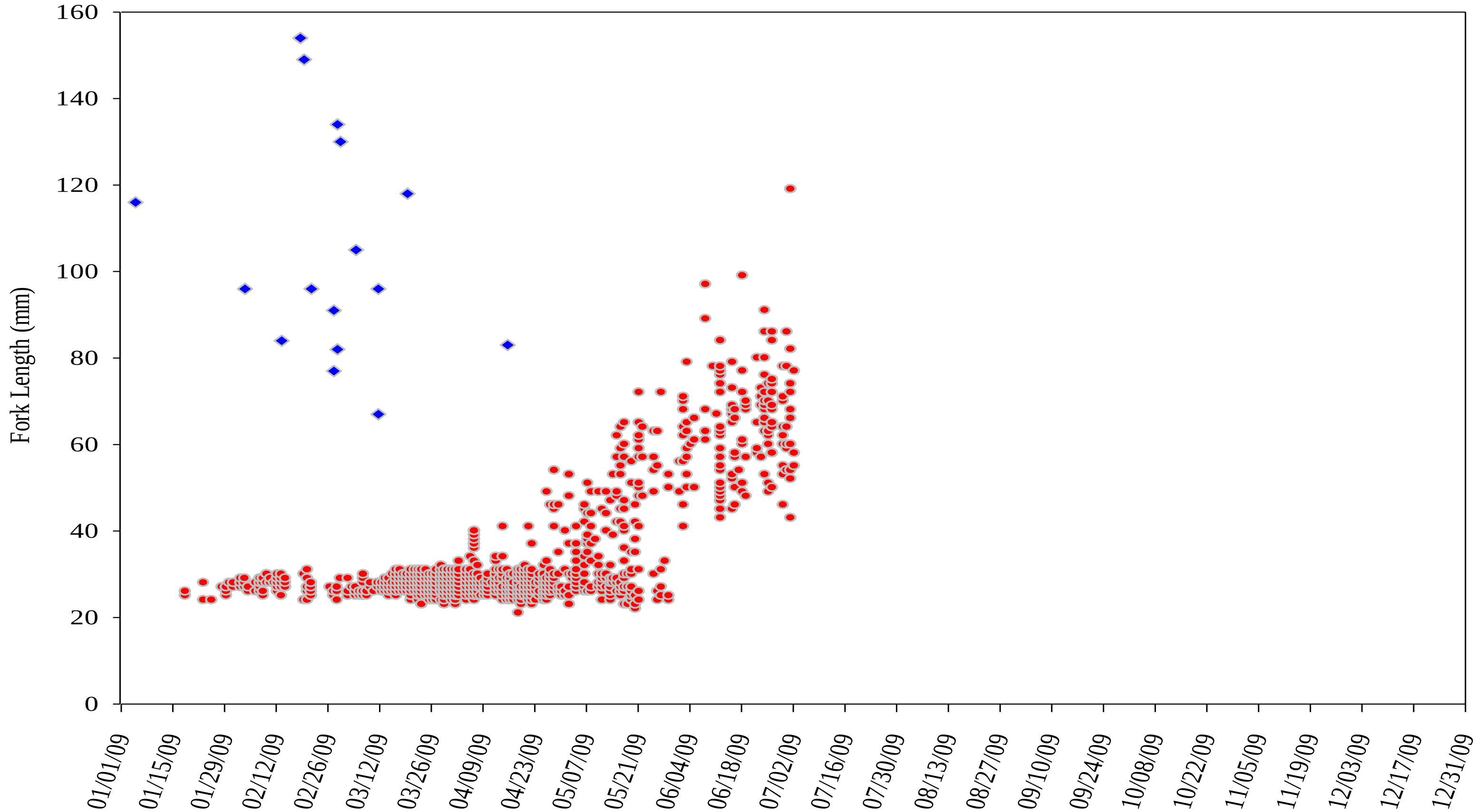

Figure 17. Fork length (mm) distribution by date for BY 2009 and BY 2008 Age 0+ steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2009 through December 31, 2009. Blue diamonds represent age 0+ steelhead trout that are of BY 2008 or earlier, while the red dots represent production from BY 2009.

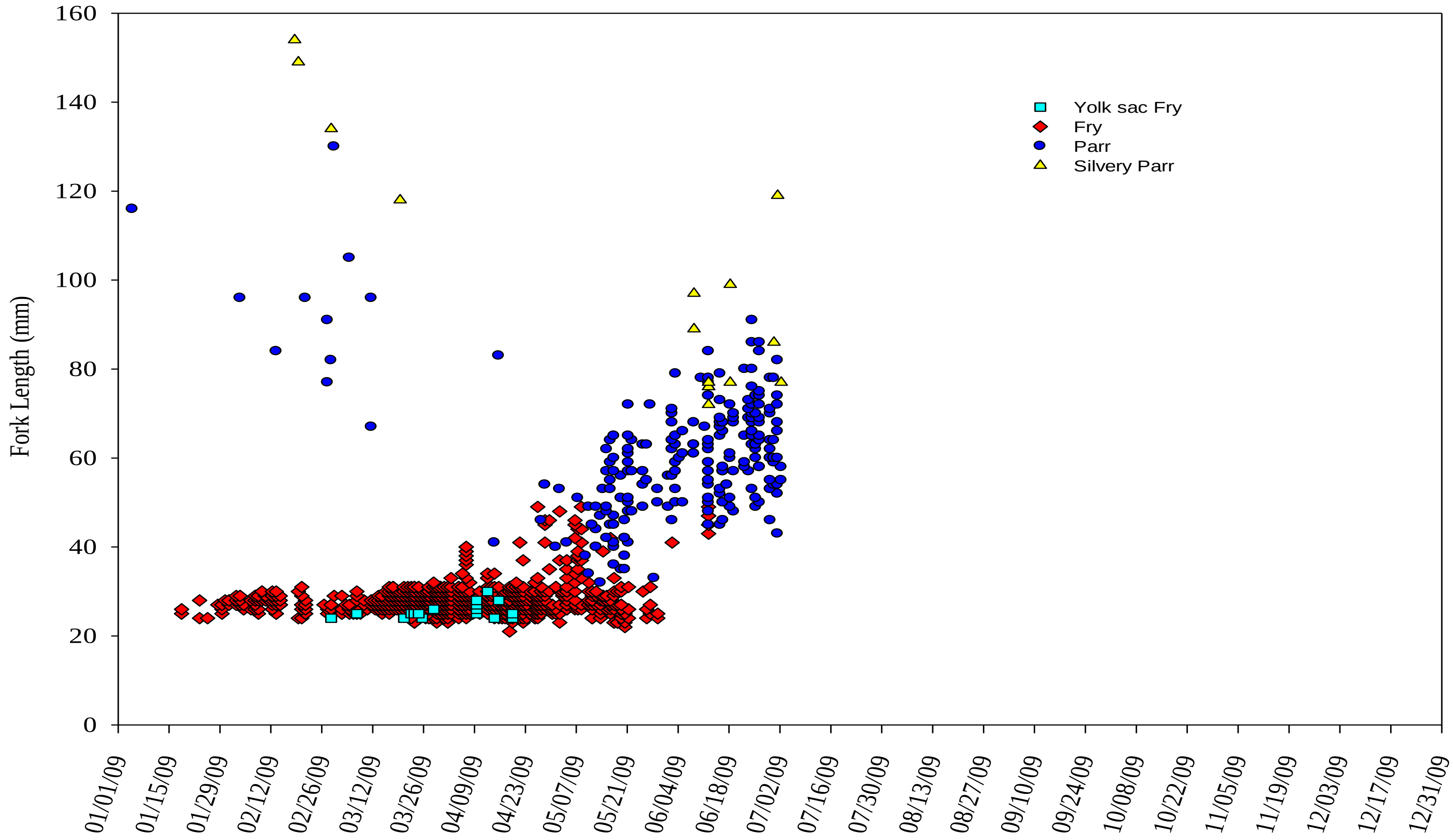

Figure 18. Life stage ratings and forklength distribution for BY 2009 and BY 2008 Age 0+ juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2009 through December 31, 2009.

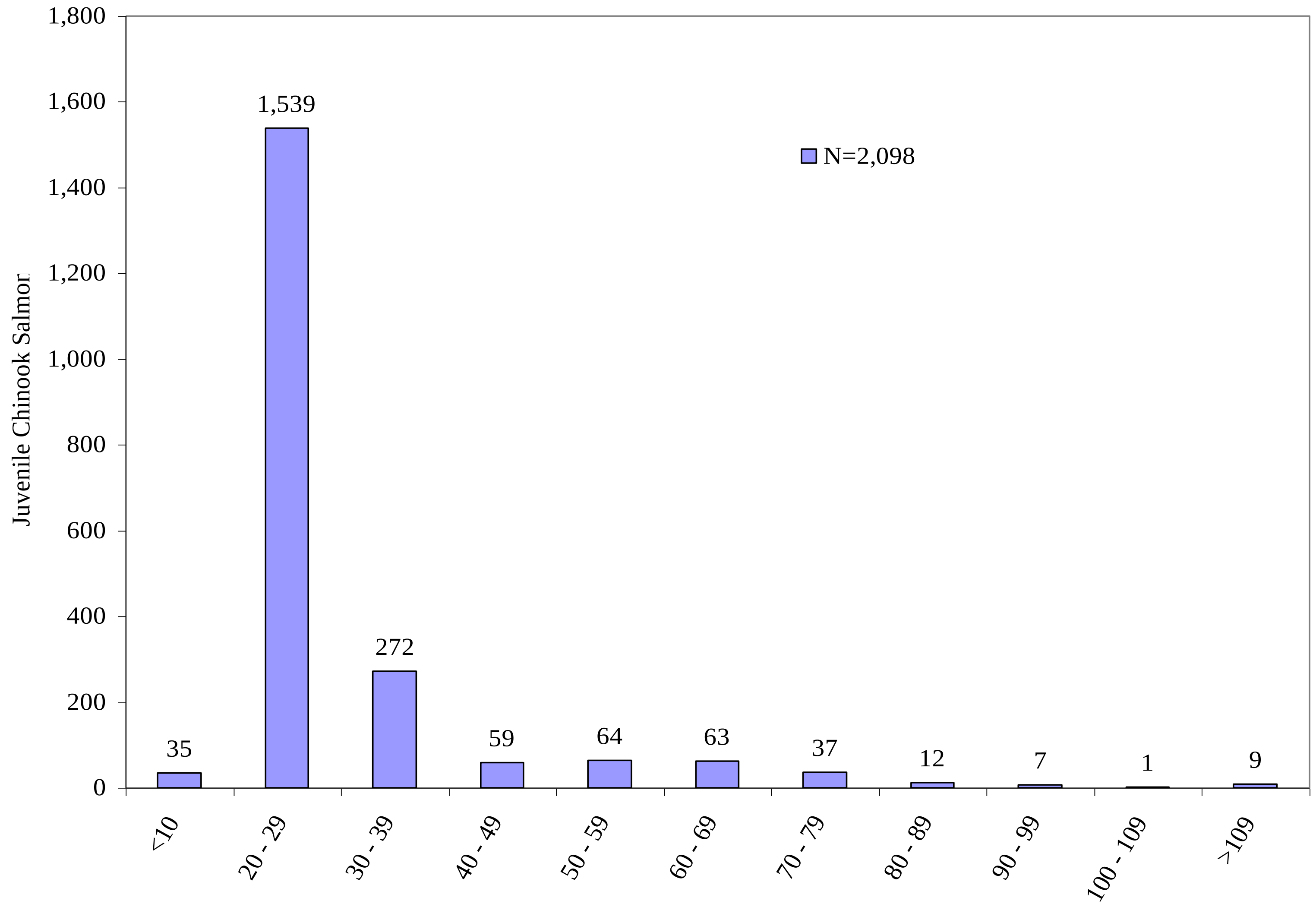

Figure 19. Fork length (mm) frequency distribution for BY 2008 and BY 2008 Age 0+ steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2009 through December 31, 2009.

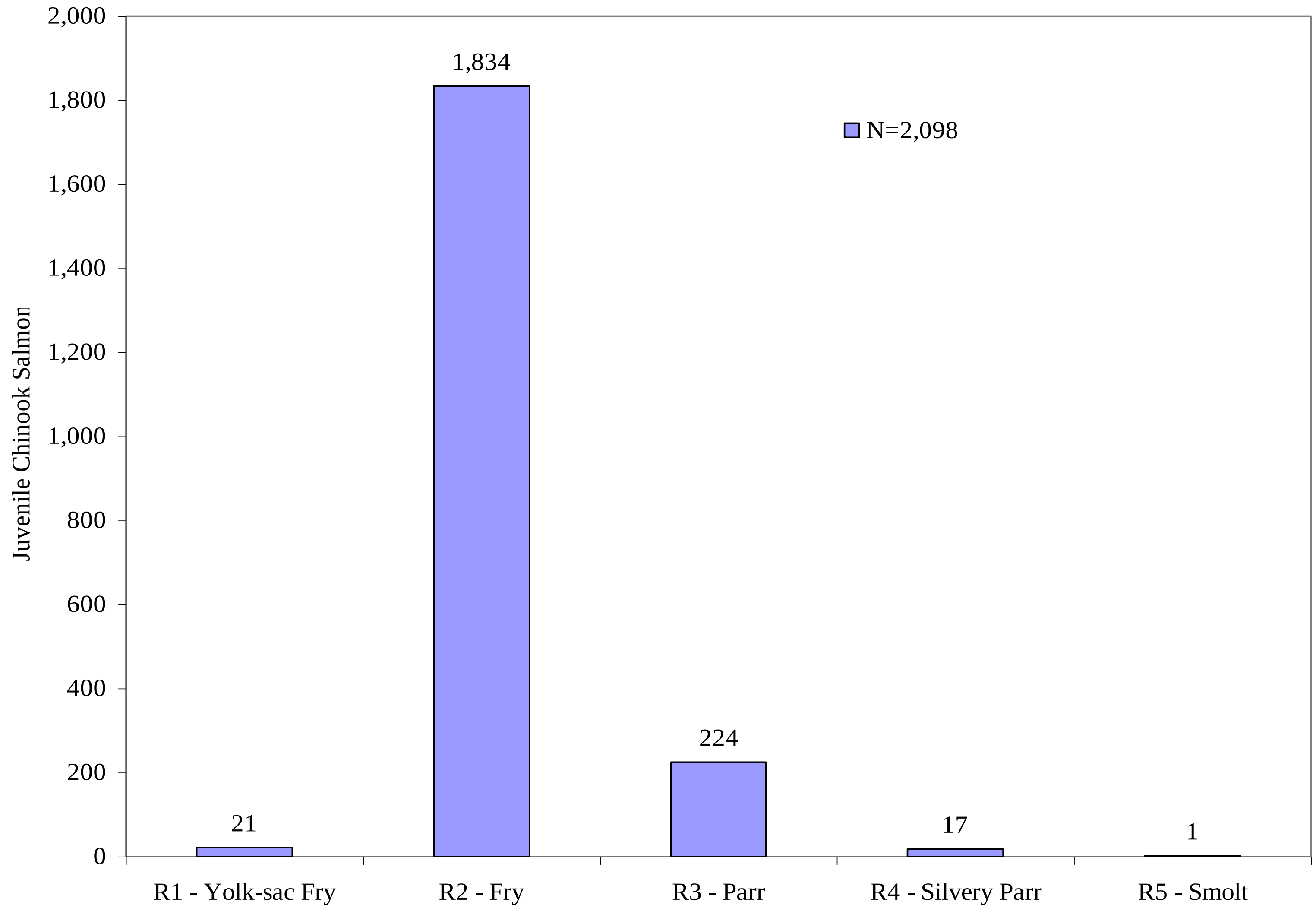

Figure 20. Life stage ratings for BY 2009 and BY 2008 Age 0+ juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2009 through December 31, 2009.

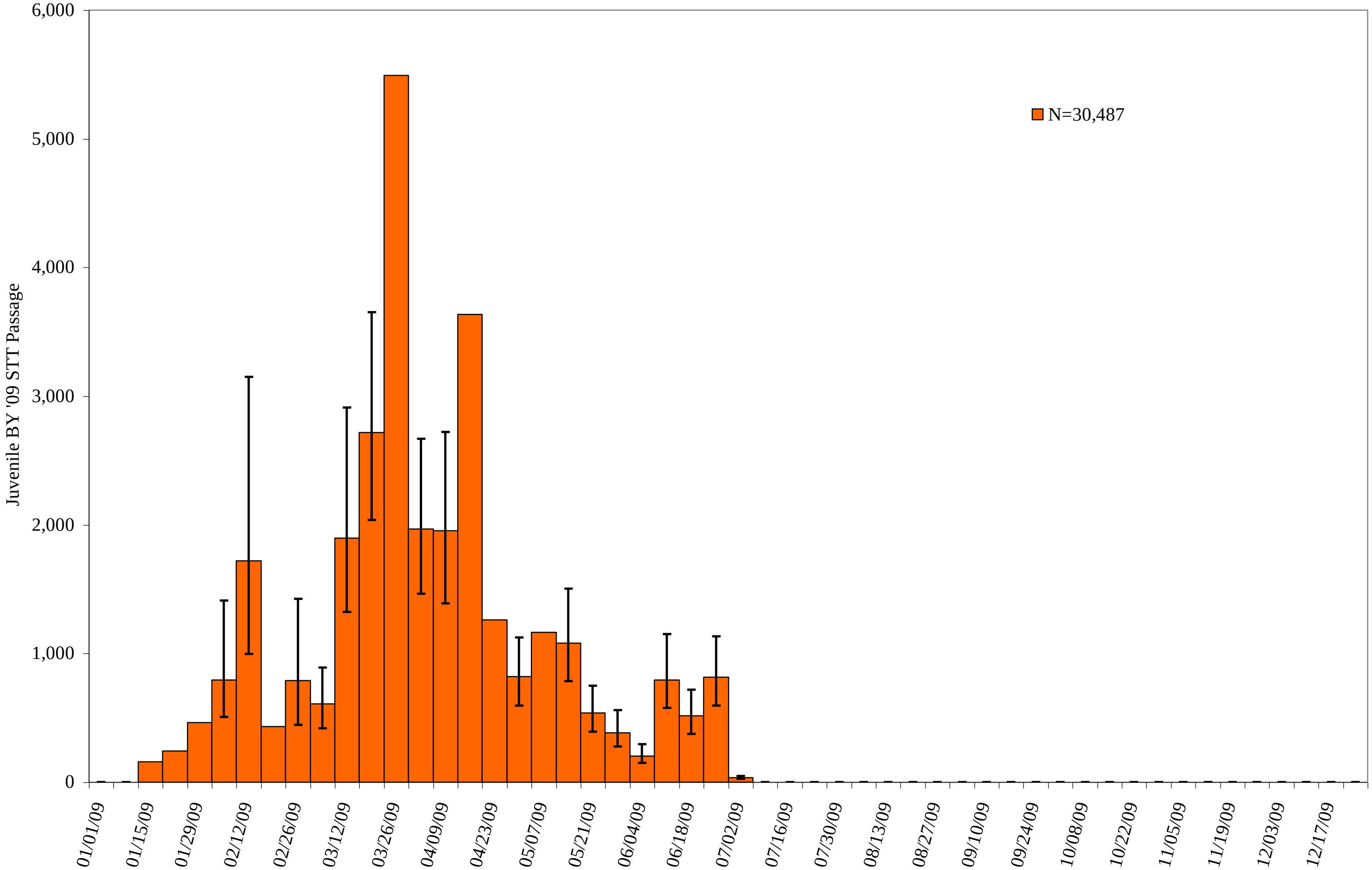

Figure 21. Passage index with 95% confidence intervals of BY 2009 juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2009 through July 2, 2009. Weeks without confidence intervals were combined and intervals could not be summed for display.

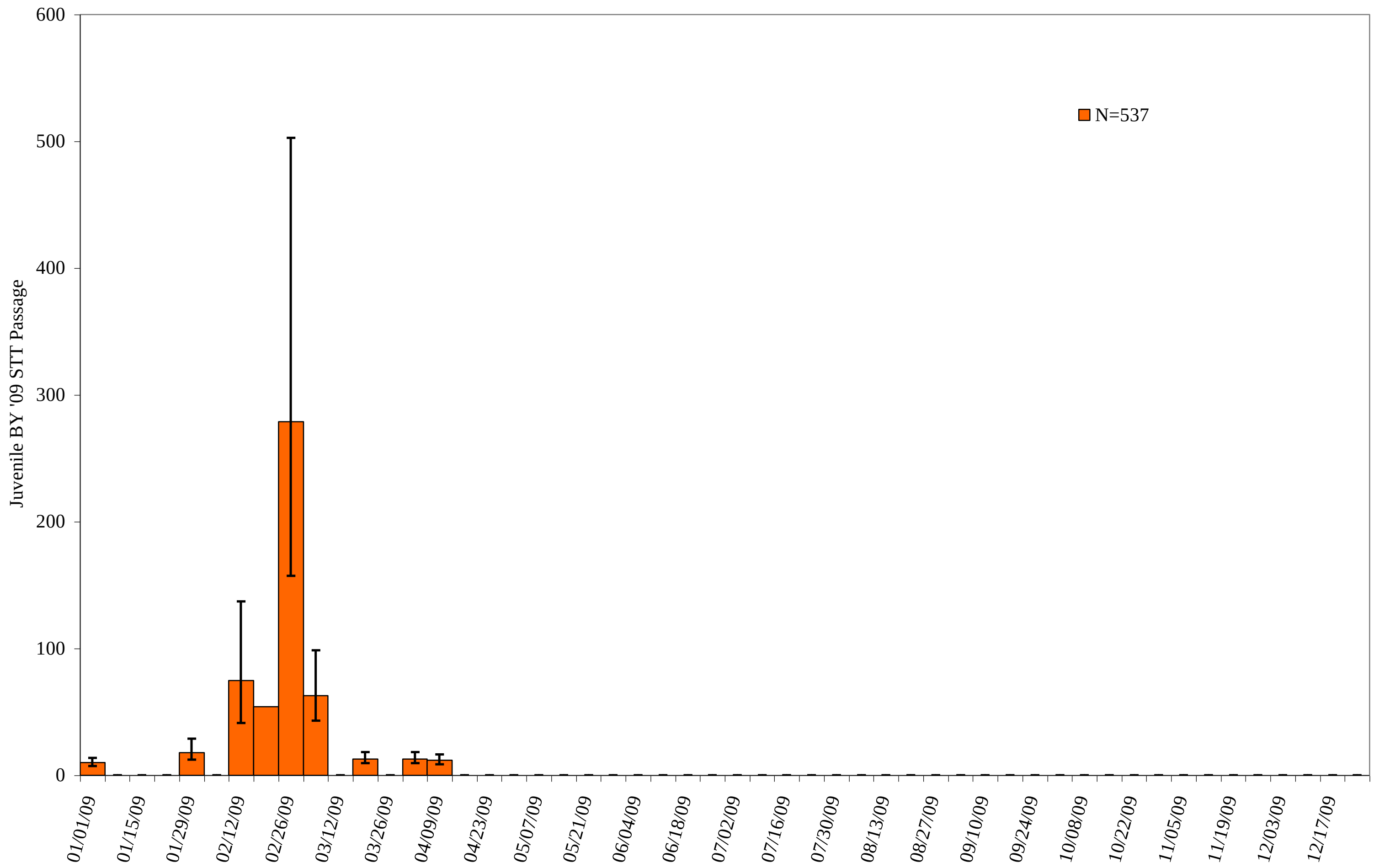

Figure 22. Passage index with 95% confidence intervals of BY 2008 juvenile steelhead / rainbow trout captured by the lower rotary screw trap at river mile 1.7 in Clear Creek, Shasta County, California by the U.S. Fish and Wildlife Service from January 1, 2009 through July 2, 2009. Weeks without confidence intervals were combined and intervals could not be summed for display.

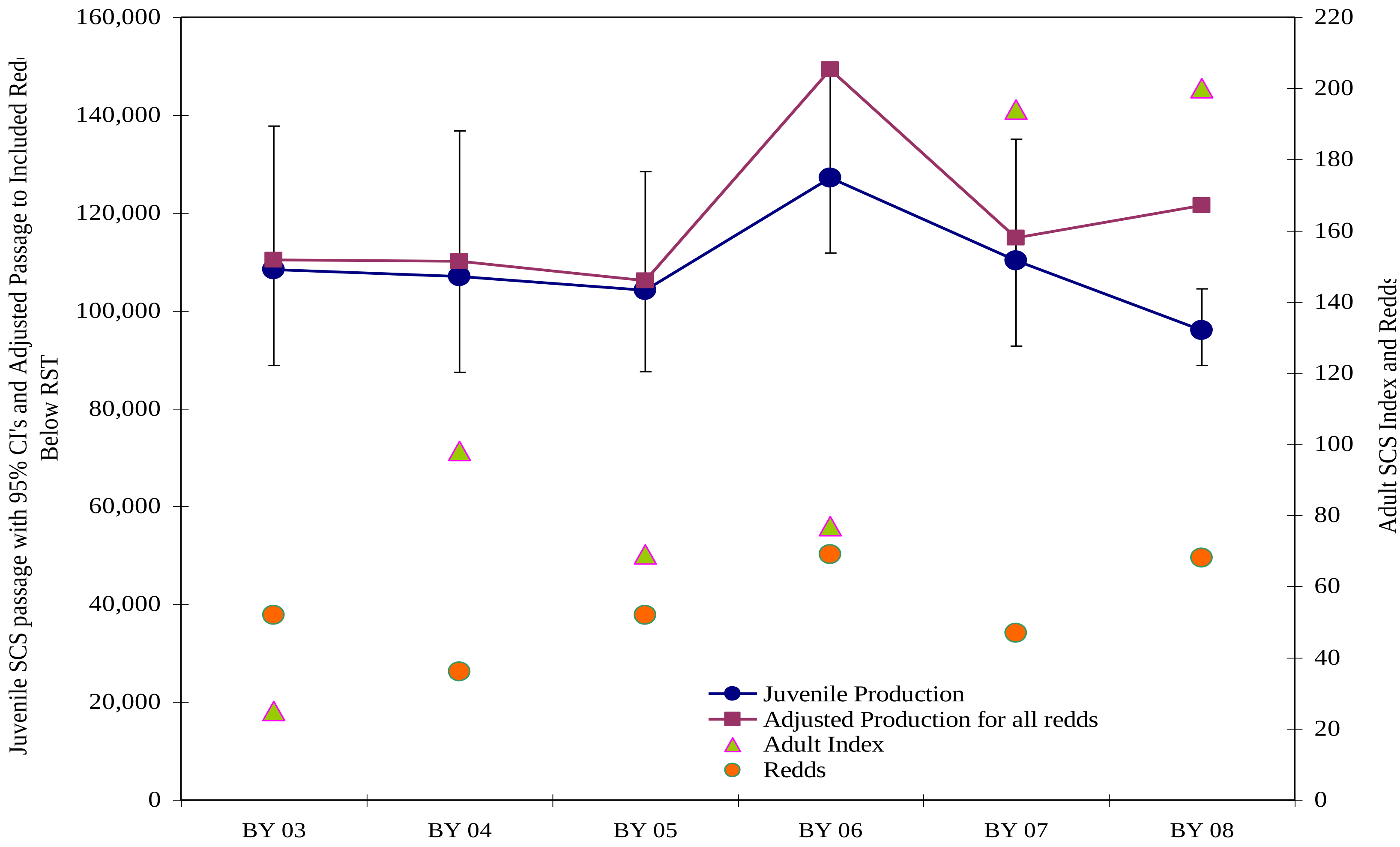

Figure 23. Spring-run Chinook passage indices with 95% Confidence Intervals (CI's), adult escapement and redds observed for BY 2003 - 2008 in Upper Clear Creek. Spring Chinook passage indices were calculated using data from the upper rotary screw trap at rm 8.3.

Appendix

Appendix 1. Name key of non salmonid fish taxa captured by the upper and lower Clear Creek rotary screw traps at river mile 8.3 and 1.7 in, Shasta County, California, by U.S. Fish and Wildlife Service from October 1, 2008 through September 30, 2009.

Abbreviation	Common Name	Scientific Name
BGS	Bluegill	*Lepomis macrochirus*
CAR	California Roach	*Hesperoleucus symmetricus*
CENFRY	Unknown Centrarchidae	*Centrarchidae spp.*
COTFRY	Unknown Cottidae	*Cottus spp.*
CYPFRY	Unknown Cyprinidae	*Cyprinidae spp.*
DACE	Speckled Dace	*Rhinichthys osculus*
GSF	Green Sunfish	*Lepomis cyanellus*
GSN	Golden Shiner	*Notomigonus crysoleucas*
HH	Hardhead	*Mylopharodon conocephalus*
LFRY	Unknown Lampetra	*Lampetra spp.*
MQF	Western Mosquitofish	*Gambusia affinis*
PL	Pacific Lamprey	*Lampetra tridentata*
RFS	Riffle Sculpin	*Cottus gulosus*
SASU	Sacramento Sucker	*Catostomus occidentalis*
SPB	Spotted Bass	*Micropterus punctulatus*
SPM	Sacramento Pikeminnow	*Ptychocheilus grandis*
TSS	Threespine Stickleback	*Gasterosteus aculeatus*
WHS	White Crappie	*Pomoxis annularis*

Appendix 2. Summary of non salmonid fish taxa captured by the upper Clear Creek rotary screw trap at river mile 8.3 in, Shasta County, California, by U.S. Fish and Wildlife Service from October 1, 2008 through September 30, 2009.

Species	Nov '08	Dec	Jan '09	Feb	Species Totals
CAR	1	1	1	0	3
HH	0	0	1	0	1
RFS	1	0	0	0	1
SASU	1	0	0	0	1
SPM	0	0	0	1	1
				Total	7

Appendix 3. Summary of non salmonid fish taxa captured by the lower Clear Creek rotary screw trap at river mile 1.7 in, Shasta County, California, by U.S. Fish and Wildlife Service from October 1, 2008 through September 30, 2009.

Species	Nov '08	Dec	Jan '09	Feb	Mar	Apr	May	Jun	Jul	Species Totals
BGS	0	0	0	0	0	1	0	0	0	1
CAR	2	2	0	0	4	4	10	68	13	103
CENFRY	0	0	0	1	0	0	9	0	0	10
COTFRY	0	0	0	0	0	0	0	3	1	4
CYPFRY	2	2	1	12	17	14	17	1	0	66
DACE	1	0	0	0	1	1	4	0	0	7
GSF	0	0	0	12	4	7	12	1	0	36
GSN	0	0	0	0	0	3	1	0	0	4
HH	1	0	0	3	12	16	17	3	1	53
LFRY	3	5	1	17	18	8	8	126	1	187
MQF	1	0	1	3	2	1	6	5	0	19
PL	8	20	11	170	2	2	0	1	0	214
RFS	8	13	4	28	35	29	14	7	0	138
SASQ	0	0	1	0	0	0	0	0	0	1
SASU	2	1	1	8	5	1	1	1	0	20
SPM	0	0	0	6	5	5	5	1	0	22
TSS	0	0	0	0	2	3	4	6	0	15
WHS	0	0	0	1	0	0	0	0	0	1
									Total	901